THURSDAY, FEBRUARY 10, 1876

OLD AND NEW WORLD SPIDERS

Descriptions of Several European and North-African Spiders. By T. Thorell. Kongl. Svenska Vetenskaps. Akademiens Handlingar, Bandet 13, n. o. 5, pp. 1—203. (Stockholm: Norstedt and Söner, 1875.)

A Collection of the Arachnological Writings of Nicolas Marcellus Hentz, M.D. Edited by Edward Burgess. With Notes and Descriptions by James H. Emerton. Forming No. II. of Occasional Papers of the Boston Society of Natural History, pp. 1—171, Pl. 1—21. (Boston: U.S.A., 1875.)

IT is a somewhat singular coincidence that the two works at the head of this article should have been published just about the same time. We shall endeavour briefly to show the value and bearing of each.

It is probably undeniable that an illustrated book on any branch of natural history is more acceptable to the public—certainly more attractive—than one wholly devoid of pictorial illustrations; and not without good reason, for it is well known what great assistance even the advanced student obtains from a single glance at an illustration, when traced by a hand well cognisant of the point sought to be illustrated, even though the hand may be entirely wanting in artistic power. The want, however, of drawings to assist the comprehension of the dry details of natural objects may be reduced to a minimum by the presence of good diagnoses. Pleasant are those pages where both these helps exist; dreary and uninviting indeed (though sometimes inevitable) are long and dry details of form, structure, and colour, when unenlivened either by drawings or diagnoses. From such dreariness Dr. Thorell's two hundred quarto pages of descriptions of spiders (under the title given at the head of this notice) are saved by the excellent diagnosis with which each description is preceded. It not unfrequently happens that a diagnosis is a mere formal abstract of the longer description that succeeds it; this is, however, not the case in the present instance, where each diagnosis puts before us just such distinctive points of special form, structure, and colour as the describer, were he at all able with his pencil, would endeavour to delineate by means of rapid sketches and dissectional drawings.

In respect to this point Dr. Thorell remarks (p. 4), that he has "prefaced his descriptions with *diagnoses*, although this is not done by the generality of modern arachnologists," it is, he says, "my firm conviction that tolerably good diagnoses very greatly facilitate the determination of unknown species, even though they be not real [by the term *real* Dr. Thorell appears to mean *full*] definitions." This places a diagnosis, in relation to the full description, exactly on a par with the part delineation and dissectional drawing when compared with a full artistic illustration; neither the diagnosis nor the dissectional drawing, however characteristic, precludes the necessity for a full description, nor for a full artistic illustration where it can be had; in fact, were it not a serious question of space and cost, amounting often to a positive bar, no natural object could be said to be well and properly described and illustrated without *a diagnosis*, such as that mentioned above, *a full description* embracing an almost photographic accuracy of every part, and (where closely allied forms exist) *a differential description* as well, besides full, and dissectional drawings. Of course the full description would be broken up into ordinal, family, generic, and specific characters, each in their proper place; the three first only requiring repetition where, in the individual examples, they happened to depart from the strict type.

The introductory pages of the work before us are in English, while the descriptions are in Latin; and the materials from which Dr. Thorell has drawn them up have been gathered from various collectors and widely distant parts of Europe, including the northern shores of Africa; which last, under the term "Mediterranean Basin," Dr. Thorell rightly joins to Europe as a single zoological province. 202 species, belonging to 51 genera, distributed among 12 families, are described, 24 of the species being given as new to science; a large proportion of the remainder, together with four new genera, having been published as new but a short time before, under the title "Diagnoses Aranearum Europæarum aliquot Novarum Scripsit." T. Thorell, in Tijds. voor Entom. Deel. xviii., 1875.

Dr. Thorell states (p. 1) that he follows here, with some slight modifications, the classification proposed in his former work "On European Spiders;" this mention gives rise to a long foot-note, of two closely-printed pages, in which he examines and criticises M. Eugène Simon's strictures of his system (published in "Aran. Nouv. ou peu Connus du Midi de l'Europe," 2e Mém.; "Mém. Soc. Roy. de Sciences de Liége," 2e ser. t. v., 1873). It is not necessary to enter here into the merits of this little passage of arms, but we come to the conclusion, on perusing it, that Dr. Thorell is probably right in saying that he "has not been so fortunate as to make himself understood" by M. Simon. At page 7, the latter author's theory respecting the eyes of spiders is discussed in another long foot-note. This theory has already been noticed in these columns (vol. xi., p. 224). Dr. Thorell, while entering fully into the question of the real nature and structure of the eyes of spiders, says, with regard to this theory, that "it is to be wished that M. Simon would somewhat more accurately describe the researches on which his views are founded; his theory is, in fact, so much the more remarkable, as no previous naturalist who has investigated the finer structure of the eyes of spiders, appears to have been aware of the existence of any distinction between day-eyes and night-eyes." Independently, however, of M. Simon's theory, the question as to the nature of spiders' eyes is a very interesting one; and very valuable would be those researches which should reveal to us the actual anatomical condition of such eyes as, for instance, the apparently atrophied, and probably useless, ones of the hind-central pair in the genus *Oecobius*, Luc.

A footnote of considerable length is appended to pages 66 and 67 on the venom of various species of the genus *Lathrodectus*, comparing it with the reputed venom of *Galeodes araneoides*, and questioning the correctness of M. Simon's conclusions (Mém. Soc. Roy., Liége, 2 ser. t. v.), that the bite of *Lathrodectus 13-guttatus* is not poisonous. Another point, also of great interest, is noted at p. 65, where Dr. Thorell speaks of traces of segmenta-

tion (somewhat like that of the abdomen of the *Phalangidea*) in the shape of an encircling furrow towards the hinder extremity of the abdomen of some species of *Lathrodectus:* and he refers to the known fact of the segmentation of the abdomen in the *embryo* of spiders (Claparède, "Recherches sur l'Evolution des Araignées"). Still plainer evidences of obsolete segments have been previously noted in *Erigone corrugis*, Cambr. (Proc. Zool. Soc., March 1875, p. 214, Pl. XXIX. Fig. 21), as well as in some other species of the same genus.

Were it not for points thus incidentally raised, and some of which have been above noticed, Dr. Thorell's present work would be of little interest except to the arachnological specialist; by such, however, it will be hailed as an important and valuable addition to the literature upon European spiders; while a more general interest is imparted to it by the topics here commented upon.

It is one of the disadvantages attending the publication of papers on natural history in periodical journals that such papers are more or less inaccessible to those who either do not possess the journal, or who live at a distance from a library containing it; and this disadvantage is heightened when a series of papers, extending, perhaps, over many years, is thus issued, on any one subject. Araneologists are therefore greatly indebted to the editor of Prof. Hentz's writings, for clearing away a disadvantage of this kind, and one which has been much felt for a considerable period.

Prof. Nicolas Marcellus Hentz, a Frenchman by birth, but obliged to fly his native country at the downfall of the first Napoleon, devoted much time and labour in the United States, the land of his adoption, to the study and collecting of spiders. After having published some few short papers upon them, at length, in 1841, he brought together the whole of his notes and drawings, publishing them in a series of papers in the Journal of the Boston Society of Natural History, at intervals from that year to the year 1850. These papers, eight in number, and contained in three vols.—iv., v., and vi.—of the Boston Journal, together with two or three other papers previously published, and an unpublished[1] supplement, have now been collected and given to the public in the present volume.

Considerable difficulties attended the attainment of this result, especially in regard to the plates; the stones from which the lithographic plates were taken having been destroyed and several of the copper plates lost. The science of photography, in the shape of the Albert-type process, has, however, enabled the editor very successfully to overcome this difficulty, and the facsimile plates produced by it are only second to those of the original papers. In order to enable araneologists to refer to and quote the exact page and plate of the original papers, care has been taken to preserve the old pagination by numbers (within brackets) inserted in the text, and to retain the original numbering of the plates alongside of the numbers referring to the present volume. The matter of the supplement has been worked into the different descriptions, wherever it happened to belong, though still kept separate by means of brackets. With this exception, and the addition of some short notes (referring chiefly to the dimensions and the occurrence of the species) by Mr. J. H. Emerton, Hentz's papers are thus now reproduced just as they were originally written and published by himself.

With regard to the subject matter of this volume, the author appears to have relied more upon the accuracy of his drawings (which were fully coloured, and said to be artistic and of great beauty) than to his descriptions for making known the spiders he discovered; his descriptions consequently are very meagre and unsatisfactory, while the engraved plates cannot be considered to do much justice to the original drawings, if the latter were, as above mentioned, artistic and beautiful; the figures in the plates, though neat, being for the most part very flat and inartistic. It is not meant by this that their utility in the determination of the spiders delineated is much, if at all, impaired; on the contrary, it will probably be found for the most part sufficiently easy for collectors to determine their captures by reference to the figures given. Every description is followed by some observations on the habits and economy of the spider, showing that the author's great pleasure was not merely in the collecting and depicting, but also in observing, the objects of his pursuit.

The system of classification adopted by Prof. Hentz is now a matter of quite secondary importance; though some (probably most) of the genera which he characterised as new, will stand; and so perhaps will the greater number of his species. The total number—254—of spiders described and figured must be considered small compared with the wide area over which they were collected; the larger number, however, appear to have been found in North Carolina and Alabama, with some few from Massachussetts and Georgia. A little vigorous collecting in those localities will doubtless soon lead to the identification of most, if not of all, of the spiders contained in Prof. Hentz's papers, and, with even less doubt, will greatly add to their number.

In thus speaking of Hentz's labours as an araneologist in the United States, it must not be forgotten that the late Dr. Abbott left behind him, many years ago, an extensive series of beautiful drawings of Georgian and other North American spiders; all of these were named and shortly described by Baron Walckenaer in vols. i. and ii. of his "Insectes Aptères" (Paris, 1837). The British Museum possesses a set of these drawings, but whether this is the original set from which Walckenaer's descriptions were derived, or whether (as we have understood) his descriptions were made from another set given to him by Dr. Abbott, and now existing in one of the public institutions of Paris, appears to be uncertain. At any rate the set of drawings in the British Museum Library bears every appearance of being an original, even if a duplicate, set; and it would perhaps be feasible, as well as worth while, now to publish these drawings as a whole, with the names and descriptions given by Walckenaer. Such a volume, in conjunction with that formed by Hentz's papers, would represent very nearly all that has been done in the past to North American Araneology, and would form a secure foundation and starting-point for the efforts of the future.

It must not be omitted to mention that the two last

[1] This supplement was published, however, latterly, under the editorial care of Mr. S. H. Scudder, in Proc. Bost. Soc. Nat. Hist., xi., pp. 103—111, Pl. 1, 2, 1867.

plates in the present volume are original ones from the skilful pencil of Mr. J. H. Emerton; these suffer in some measure (as do also some of the others) from their production by the Albert-type process; but in point of accurate detail and artistic finish their figures are immeasurably in advance of those engraved from Hentz's drawings. It is to Mr. Emerton, who appears to have resolutely entered upon the field of araneology, and to his great powers of delineation, that the arachnologists of the Old World now look for the thorough working out and illustration of the Spiders of North America.

O. P. C.

DYEING AND CALICO PRINTING

Dyeing and Calico Printing, including an Account of the Most Recent Improvements in the Manufacture and Use of Aniline Colours. By the late Dr. F. Crace-Calvert, F.R.S., F.C.S. Edited by John Stenhouse, LL.D., F.R.S., &c., and Charles Edward Groves, F.C.S. (Manchester: Palmer and Howe; London: Simpkin, Marshall, and Co., 1876)

THE subjects treated of in the volume now before us possess a twofold interest—first as involving questions of pure science in the domain of organic chemistry; and secondly, as being of immense industrial importance to the country. It does not enter into our province to notice the work in its industrial aspect, but we have no hesitation in stating that author and editors have performed their task in a highly creditable manner. From every point of view the work will be found useful, and we can recommend it to the scientific chemist as well as to dyers and calico printers.

The author, who died in 1873, had been occupied up to the time of his death in preparing a treatise on colouring matters other than aniline. The present work has been edited from the author's MSS. with the addition of five chapters, forming a considerable portion of the book, on the coal-tar colours, by the editors.

The mode of treatment pursued is nearly the same for each dye. The natural history and source of the material from which the colour is obtained are first given, then the chemical composition and mode of preparation or manufacture, and finally the method of application to the various fabrics described. The whole subject is profusely illustrated by specimens of dyed and printed fabrics pasted into the book.

The work is appropriately prefaced by an obituary notice of the author. The first chapter treats of colour in general and the action of different forces, chemical agents, &c., on the various colouring matters. We must object to the definition of colour given in this chapter. It is defined as "the impression that the light reflected from a surface makes upon the eye," thus excluding all cases in which colour is caused by *absorption*.

Chapters II. and III. are entirely devoted to madder dyes, and contain, among much valuable chemical information, a description of Prof. Stokes's optical tests for alizarin and purpurin. The method of dyeing in Turkey red and the action of different mordants in madder and garancin painting is clearly explained, and the manufacture of artificial alizarin described. Chapter IV. treats of the red dyewoods—logwood, sapan, Lima, peach, and Brazil woods; also of safflower and alkanet. Chapters V. and VI. are devoted to indigo—this portion of the subject being described in considerable detail. Chapter VII. contains accounts of cochineal, kermes, gumlac, lac dye, lac lake, and murexide, while Chapter VIII. treats of orchil, cudbear, and litmus. In Chapter IX. some of the important yellow colouring matters are treated of, such as quercitron, fustic, Persian berries, weld, aloes, turmeric, annatto, &c.; while tannin matters form the subject of Chapter X., the most important of these being sumach and catechu. Chapter XI. contains descriptions of the methods employed for testing and determining the commercial value of particular samples of the various dyestuffs. In this chapter will be found described some of the different forms of "colorometers" which have been devised for estimating the colouring power of dyes.

The portion of the work devoted to the coal-tar colours commencing with Chapter XII. begins with an account of the various bodies which have been found in coal-tar. A list of thirty-eight distinct compounds is given, and many more doubtless exist. The most important substance produced in the dry distillation of coal, so far as the dye manufacturer is concerned, is benzene. The conversion of this substance into aniline is explained, and the manufacture of magenta described, the chapter concluding with an account of safranine and some other aniline reds. Chapter XIII. treats of aniline violets, and blues such as mauve, the Hofmann and methyl-aniline violets, diphenylamine, and Nicholson's blues, &c. In Chapter XIV. we have a description of the greens, aldehyde, iodine, and methyl-aniline and the aniline yellows, phosphine, zinaline, &c. Chapter XV. treats of aniline black and brown, and the concluding chapter is devoted to the phenol, cresol, and naphthalene colours, including picric acid, corallin, aurin, and others. Not the least useful portion of the book will be found the tables at the end, which consist, first of a list of the madder-colouring matters, their formulæ, and reactions, and then a series of tables, which will enable the analyst to distinguish the different colours when fixed on fabrics.

The above imperfect sketch of the present volume will enable our readers to form an idea of the immense number of distinct compounds used in dyeing and calico printing, and the apparently heterogeneous nature of the products, both natural and artificial, called upon to furnish materials for these arts. It must not be forgotten that the enormous development of these industrial arts within the last few years is entirely due to researches undertaken in the first instance without special regard to the commercial aspects of the questions involved—witness the accidental discovery of mauve, the first of the aniline dyes, in the course of an investigation for obtaining quinine by artificial means.

The manufacture of alizarin, the colouring principle of madder, is another triumph of organic chemistry, of which the present generation may justly be proud. It is perhaps not going too far to look for a similar achievement with regard to indigo—in point of fact we may remind our readers that the colour-giving principle of this substance has already been synthesised by the following series of reactions.

A mixture of dried calcium, acetate, and benzoate is

submitted to distillation in order to obtain the ketone known as acetophenone :—

$$Ca\left\{\begin{matrix}OC_2H_3O\\OC_2H_3O\end{matrix}\right. + Ca\left\{\begin{matrix}OC_7H_5O\\OC_7H_5O\end{matrix}\right. = 2CO\left\{\begin{matrix}CH_3\\C_6H_5\end{matrix}\right. + 2CaCO_3$$

Calcium acetate. Calcium benzoate. Methyl-phenyl ketone. Calcium carbonate.

Methyl-phenyl ketone when treated with fuming nitric acid yields two isomeric nitro-derivatives, $C_8H_7(NO_2)O$, one of which when heated with a reducing mixture composed of zinc dust and soda lime is converted into indigo blue :—

$$2C_8H_7(NO_2)O - 2H_2O - O_2 = C_{16}H_{10}N_2O_2$$

Nitro-acetophenone. Indigo blue.

The process above given is at present only valuable from a scientific point of view, since the yield of indigotin is but small. It yet remains to convert this laboratory reaction into a practicable process, in order to do for indigotin what has already been accomplished for alizarin, and thus completely revolutionise another large branch of the colour-producing industry.

R. MELDOLA

OUR BOOK SHELF

Scientific Culture. By Josiah P. Cooke, Jun., Professor of Chemistry and Mineralogy in Harvard College (U.S.). (London : H. S. King and Co., 1876.)

THIS is altogether an admirable address, characterised by real eloquence and by clearness and decision of view as to the place which science ought to occupy in any system of education. Most of Prof. Cooke's audience were teachers by profession, attending Harvard University mainly to become acquainted with the experimental methods of teaching physical science. We commend the address not only to scientific students and teachers of science, but to all who take an interest in education, and to all students who desire a clear statement as to what, in the not distant future, will be regarded as the only liberal education, an education in which science will be allotted a place of at least equal importance with that of literature. What Mr. Cooke's views are on certain matters which have for long been discussed in this journal, may be learned from the following extracts. On the place which Science ought to occupy in education, he says :—

"I must declare my conviction that no educated man can expect to realise his best possibilities of usefulness without a practical knowledge of the methods of experimental science. If he is to be a physician, his whole success will depend on the skill with which he can use these great tools of modern civilisation. If he is to be a lawyer, his advancement will in no small measure be determined by the acuteness with which he can criticise the manner in which the same tools have been used by his own or his opponent's clients. If he is to be a clergyman, he must take sides in the great conflict between theology and science, which is now raging in the world, and unless he wishes to play the part of the doughty knight, Don Quixote, and think he is winning great victories by knocking down the imaginary adversaries which his ignorance has set up, he must try the steel of his adversary's blade. . . . .

"I feel that any system of education is radically defective which does not comprise a sufficient training in the methods of experimental science to make the mass of our educated men familiar with this tool of modern civilisation ; so that when, hereafter, new conquests over matter are announced, and great discoveries are proclaimed, they may be able not only to understand but also to criticise the methods by which the assumed results have been reached, and thus be in a position to distinguish between the true and the false. Whether we will or not, we must live under the direction of this great power of modern society, and the only question is whether we will be its ignorant slave or its intelligent servant."

On the uses to which Universities should be put, Mr. Cooke's opinions are decided :—

"The time has passed when we can afford to limit the work of our higher institutions of learning to teaching knowledge already acquired. Henceforth the investigation of unsolved problems, and the discovery of new truth, should be one of the main objects at our universities, and no cost should be grudged which is required to maintain at them the most active minds in every branch of knowledge which the country can be stimulated to produce.

"I could urge this on the self-interest of the nation as an obvious dictate of political economy. I could say, and say truly, that the culture of science will help us to develop those latent resources of which we are so proud ; will enable us to grow two blades of grass where one grew before ; to extract a larger per cent. of metal from our ores ; to economise our coal, and in general to direct our waiting energies so that they may produce a more abundant pecuniary reward. . . . This is all true, and may be urged properly if higher considerations will not prevail. It is an argument I have used in other places, but I will not use it here ; although I gladly acknowledge the Providence which brings at last even material fruits to reward conscientious labour for the advancement of knowledge and the intellectual elevation of mankind. I would rather point to that far greater multitude who have worked in faith for the love of knowledge, and who have ennobled themselves and ennobled their nation, not because they have added to its material prosperity, but because they have made themselves and made their fellows more noble men."

These are but small samples of the many good things contained in Prof. Cooke's address, which we should like to see in the hands of all students. The latter portion of the address students of mineralogy will find of special value.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

On the most Northerly Latitude at which Land and Freshwater Molluscs have hitherto been found

I AM very sorry that I have involuntarily made a mistake in a letter to Mr. Oscar Dickson (NATURE, vol. xiii. p. 96), in which it is stated that Dr. Stuxberg had found a Physa on the most northerly locality from which land and freshwater molluscs have hitherto been obtained. When I made this statement I had not Middendorff's "Sibiritche Reise" with me, and I did not then remember that this celebrated naturalist had found a species of the same genus on the Taimur peninsula north of the seventy-third degree N.L. A. E. NORDENSKJÖLD

Stockholm, Jan. 29

Prof. Tyndall on Germs

HAVING commented elsewhere (*Lancet* and *Brit. Med. Journ.* Feb. 5) upon Prof. Tyndall's recent attempt to establish the truth of the Germ Theory of Disease, my remarks in your columns may be very brief.

Prof. Tyndall tells the public he has uniformly failed to obtain evidences of putrefaction in previously boiled organic infusions protected from contamination by atmospheric particles.

The following investigators have, however, with one or other fluid, been able to obtain such results :—

1. Schwann, *Isis*, 1837 ; Poggendorff's *Annalen*, 1837.
2. Mantegazza, *Giorn. dell. R. Istit. Lombard.*, t. iii., 1851.
3. Schroeder and Dusch, *Annal. de Chimie*, tome xli., 1854.
4. Schroeder, Liebig's *Annalen*, cix., 1859, and *Chem. News*, vol. v., 1862.

5. Pouchet, *Hétérogénie*, 1859, and *Nouvelles Expériences*, &c., 1864.
6. Pasteur, *Ann. de Chimie*, 1862 (see pp. 60-62),
7. Joly and Musset, *Compt. Rend.*, 1861 and 1862.
8. Jeffries Wyman, *American Journal of Science*, vol. xxxiv., 1862, and vol. xliv., 1867.
9. Victor Meunier, *Compt. Rend.*, tome xli., 1805.
10. Child, *Proceed. of Roy. Soc.*, June 1864, and April 1865.
11. Hughes Bennett, *Ed. Med. Journ.*, 1868.
12. Cantoni, *Gaz. Med. Ital. Lombard.*, tome i., 1868.
13. Bastian, NATURE, 1870; *Modes of Origin*, &c., 1871; *The Beginnings of Life*, 1872.
14. Burdon Sanderson, NATURE, Jan. 8 and June 1873; *Med. Times and Gaz.*, Oct. 22, 1873.
15. Huizinga, NATURE, March 20, 1873, and Pflüger's *Archiv*, vols. vii. and viii.
16. Lankester and Pode, *Proceed. of Roy. Soc.*, vol. xxi., 1873.
17. Roberts, *Phil. Trans.*, vol clxiv., 1874.
18. Samuelson, Pflüger's *Archiv*, vol. vii., 1874.
19. Gscheidlen, quoted by Dr. Sanderson in *Academy*, July 10, 1875.

I have set down the names in order of time, and included my own amongst them because those mentioned after me have all confirmed my results with regard to the putrefaction of some fluids in hermetically sealed vessels, from which the air has been expelled by boiling; the very experiments, in fact, which Prof. Tyndall now endeavours to impeach by his own one hundred and thirty-nine failures.

Dr. Burdon Sanderson's well-known corroboration of the accuracy of my results may be here reproduced. He says (NATURE, January 8, 1873):—"The accuracy of Dr. Bastian's statement of fact with reference to the particular experiments now under consideration has been publicly questioned. I myself doubted it, and expressed my doubts, if not publicly, at least in conversation. I am content to have established—at all events, to my own satisfaction—that, by following Dr. Bastian's directions, infusions can be prepared which are not deprived by an ebullition of from five to ten minutes of the faculty of undergoing those chemical changes which are characterised by the presence of swarms of Bacteria, and that the development of these organisms can proceed with the greatest activity in hermetically sealed glass vessels, from which almost the whole of the air had been expelled by boiling."

And, if Prof. Tyndall and others wish to know how far these results have since been generally recognised as correct, reference may be made to a review of my work, "Evolution and the Origin of Life," by Dr. Burdon Sanderson, in the *Academy* of July 10, 1875. There, in reference to the confirmation which these experiments had received, and in relation to other work in connection with the question generally by Samuelson and Gscheidlen, Dr. Sanderson writes:—"As regards the trustworthy character of the experiments themselves, it will probably be a sufficient guarantee to most readers that they have been conducted under the immediate supervision of men like Pflüger and Hoppe-Seyler, who occupy the foremost rank as vital physicists. Those who are more especially interested in the subject will best satisfy themselves of the exactitude and completeness with which all the investigations have been carried out by reading for themselves the original papers."

Although Dr. Sanderson thus thoroughly recognises the fact (and knows that others do the same) that many boiled fluids will putrefy in closed vessels from which air has been expelled by boiling, it is well known that he is not willing to regard such facts as the proof of the occurrence of "spontaneous generation." He admits, indeed (*British Medical Journal*, February 13, 1875, p. 201), that I and others have shown that Bacteria in their "ordinary state" are killed by a temperature of about 140° F.; but, instead of accepting "spontaneous generation" as an explanation of the occurrence of living organisms in the vessels above referred to, he pleads in favour of the only other possible explanation, viz., a "latent vitality" in some Bacteria-germs not extinguishable by exposure for ten minutes or so to the influence of boiling water. I felt it my duty to refer to this hypothesis in my address at the Pathological Society last year (*British Medical Journal*, April 10, 1875, p. 473); but, whatever its worth may be, Dr. Sanderson, whose learning and knowledge of the whole question few will dispute, knows that this, or some such hypothesis, alone stands in the way of the acceptance of "spontaneous generation" as a proved reality.

Prof. Tyndall, however, seems to regard this hypothesis as undeserving of notice. He makes no sort of reference to it, and agrees with me in thinking that Bacteria and their germs are decidedly killed by five minutes' boiling in organic infusions. He still further supports the view held by me, in opposition to that of M. Pasteur, that such a result follows both with alkaline and with acid infusions.

This may seem to many of my readers a rather remarkable finale when compared with Prof. Tyndall's own anticipations; but I feel thoroughly assured that those who understand the subject will see that, in the present stage of the controversy, no other conclusions of value are deducible from his recent experiments. He appears to have completely misapprehended the present state of knowledge on the question; he has uniformly failed to obtain results which are now firmly established; and, as regards the only question which is at present in dispute, he unhesitatingly coincides with me.

Feb. 7 H. CHARLTON BASTIAN

I HAVE read with great interest and pleasure Prof. Tyndall's paper on Germs. But I am troubled on one point. I am sure Prof. Tyndall will not think my difficulties unworthy of attention and removal, though I confess that I am only one of that unpretending class to whose enjoyment and instruction he has devoted so large a share of his valuable time. I am an outsider in scientific research; I delight to follow every investigation which tends to the development of science; but I have not the time, and, if time were available, perhaps I should find that I had not the skill to conduct experiments for myself. I have to trust—and I have seldom found myself misled by trusting—to the recorded experiments of men whose reputation has been established by prolonged and valuable work. I cannot willingly give up this trust, and yet there is one passage in Prof. Tyndall's paper which almost forces me to do so. He tells us that in 139 instances he boiled organic solutions in flasks which were then hermetically sealed, and that in no one case did putrefaction accompanied by Bacteria occur. The inference he draws from this "cloud of witnesses" is that Bacteria cannot be developed in flasks so treated.

Precisely the opposite conclusion appears to have been arrived at by Prof. Burdon Sanderson (NATURE, vol. vii. p. 180). He also tested organic fluids in flasks boiled and hermetically sealed, and he found that putrefaction, with swarms of Bacteria, frequently followed. He considered it established that the development of Bacteria could proceed with the greatest activity in hermetically sealed glass vessels previously subjected to boiling heat.

I observe that Prof. Tyndall suggests that such contradictory results may be explained by "errors of preparation or observation." No doubt they may, but it would be a great shock to my scientific faith to be driven to this theory to explain apparent discrepancies between such observers as Professors Tyndall and Sanderson. I cannot help, not only hoping, but believing that there must be some way of reconciling the experiments of two such eminent inquirers, and I should be much perplexed if I were compelled to form an opinion whether the supposed error, if it does exist, ought to be attributed to the one or the other.

Can Prof. Tyndall relieve me from the necessity of believing that either went astray in his work? May there not have been some variations in the conditions which would allow us to accept both sets of experiments as sound? On carefully comparing the two I find that Prof. Tyndall's experiments are far more numerous than those tried by Prof. Sanderson. On the other hand, I find that Prof. Sanderson describes with admirable precision all the details of his work. Perhaps it scarcely fell within the scope of Prof. Tyndall's discourse to descend to such minutiæ, but it may very well be that a more particular description, such as that which Prof. Sanderson published, of his treatment of the hermetically-closed flasks—as to the preparation of the solutions, and their specific gravity, the mode and duration of the heating, the method and temperature of the developing treatment, and the like—would supply the means of reconciling his results with the apparently contradictory results arrived at by his brother professor.

When we are considering the conclusions of men of science of the highest calibre I do not think that over much weight should be attached to their preconceived expectations. Still, so far as they go, the avowed opinions of Prof. Sanderson before trying his experiments do tend to reinforce their value. He obtained results which he did not anticipate, and that after taking very careful precautions to exclude the possibility of errors of observation. The errors may have crept in notwithstanding, but it is especially uncomfortable to us outsiders to think

this possible, and I for one cannot believe it until I know whether the conflict between the two professors may not be explained by differences in the conditions under which they worked.

We all know how fully Professor Tyndall's time is occupied, but I hope it is not too much to ask him, in the interests of science and for our instruction, to add to the scientific value of his experiments on hermetically sealed flasks by publishing the details, so as to enable us to compare them with the careful account which Prof. Sanderson gives of his, and to judge whether we ought to trust the one or the other or—what would be the more agreeable, and I cannot help thinking the more likely, consequence—to trust them both in this as we have done in so many previous investigations.

INQUIRER

The University of London and School Examinations

HAVING given some assistance to the preparation of the Report referred to in your leader of the 3rd inst., I shall be glad if you will allow me to correct the somewhat erroneous impression which I fear your article is likely to produce.

It was with some surprise that I found the Report of the Sub-committee of the Convocation of the University of London forming the subject of an editorial notice, seeing that, as yet, it is private matter printed only for circulation among the members of the University. At the recent meeting of Convocation I endeavoured to explain the position which the Annual Committee occupied with respect to this Report; and from the absence of all reference to the subject in the notices of the meeting which appeared in the daily papers, I had reason to think that I had succeeded in showing why the matter was not yet ripe for publication. In answer therefore to your query: "But is it easy to speak with reasonable seriousness of an attitude like that which the Annual Committee has adopted?" I need now only state, with respect to the Report, that it is not yet adopted by Convocation nor by the Annual Committee.

But I am inclined to think that you have lacked the opportunity of carefully studying the proposals of the Sub-Committee, or you would not have found it necessary to speak of them in terms of "irony" or "levity."

Your article suggests that the University of London has been asked to adopt a scheme for the examination of schools with no higher motive than that of "entangling schoolboys in its meshes," and of withdrawing them from the influence of the other Universities; and to establish this position you quote a passage from one of the paragraphs of the Report, in which, *inter alia*, it is stated that unless the University of London is prepared to take some part in the examination of schools "*the number of candidates for the London examinations will sensibly decrease*," which last words you have printed in italics, although in the Report itself no such prominence is given to them. It is quite true that the graduates of Burlington Gardens consider that the influence which their examinations exert on education is, on the whole, beneficial. They are consequently desirous that that influence should if possible be extended, and would view with regret, as the Report suggests, any cause that might tend to dissociate from the University of London those schools which hitherto had acted as feeders to it. But is it quite fair to characterise this honest endeavour to improve school-teaching as an attempt to *entangle schoolboys within the meshes of the University?*

Your article further states that the Annual Committee have not a word to say as to the efficiency of the work in which the ancient Universities have for many years been successfully engaged. Indeed they have: but it is not likely to be found in the Report of the Sub-committee. The several weighty reasons which have induced Convocation to request the Senate to undertake the examination and inspection of schools have been repeatedly and fully discussed by Convocation and its Committee; and the result of these discussions has been the appointment of a Sub-committee for the purpose of suggesting what might seem to them the best and most comprehensive system of examination. Nothing would be easier, in reply to your article, than to show how the proposals embodied in the Report of the Sub-committee, if ultimately adopted by the Senate, would tend to the improvement of secondary education, and would entitle the University of London to receive that "debt of gratitude" which you say "the nation would owe it," if it undertook in good faith to offer to schools a better system of examination than they at present possess. But I am not at liberty to publish the contents of a Report which is at present nothing more than a series of recommendations which the Annual Committee have accepted as the basis of conference between Convocation and the Senate. I may, however, be permitted to refer to one important feature in that Report which I might have expected would have gained for it the support of a scientific journal such as NATURE—that in the examinations for certificates the same weight is given to Science as to Languages and Mathematics. If the University of London should determine to undertake the new duties to which the Report refers, many schools would be enabled to choose between two systems of examination differing in many essential particulars from each other; but what is more important is the fact that the scheme of the University of London would cover a far wider range of schools than is included within that of the Joint-Board of Oxford and Cambridge; and that those schools which stand most in need of careful inspection would, for the first time, have the opportunity of being affiliated to a University.

In conclusion, permit me to add, that so far from desiring to compete with the older Universities, the Senate of the University of London expressed a strong desire to co-operate with Oxford and Cambridge in their great educational work; and it was not till after the Joint-Board had given reasons why they were unable to act in conjunction with London, that independent action was even suggested.

PHILIP MAGNUS

Feb. 5

WILL you spare me a few lines of space to reply to your first article of Thursday last? A portion of that article was directed against examinations in general, and would apply to the Oxford and Cambridge scheme, as well as to that put forward by our Sub-committee; far more so, in fact, as an important part of our scheme relates to inspection of methods of teaching, school-books, &c., which is not included in the conjoint scheme of the older Universities. Our object is to improve the education given in schools other than primary; and if the author of your article will suggest any method besides examination and inspection by which this may be effected, we will gladly give it our earnest consideration.

Our Report was drawn up for the Annual Committee of Convocation, and not for the outside world. It was not necessary for us to inform Convocation that the University of London has a tradition and principles of its own, principles distinct from, and sometimes antagonistic to those of Oxford and Cambridge. Among these traditional principles are, firstly, that all education ought to be *many-sided*, and not solely either mathematical or classical, and secondly, that Science ought to hold a place co-ordinate with Language and Mathematics. It was not necessary for us to point out to Convocation that if the number of candidates for the London examinations were sensibly to decrease, these two principles would have a diminished influence upon the education of the country, for there is in Convocation a strong attachment to these principles, and a vivid appreciation of the *raison d'être* of the University. Neither was it necessary for us to state what we thought the deficiencies of the Oxford and Cambridge Local Examinations. It was upon the ground that these examinations tended to become too much "an end instead of a means" that we were commissioned by Convocation to draw up a scheme, under which we should rather inquire whether the schools have done well what they profess to have done than dictate to them what course of studies they should pursue. A careful comparison of our scheme with that of the Conjoint Board will make the divergence of aim apparent.

And now we are advised to admit that we have no independent mission as a University, and to stand by to see whether or not the older Universities will do our work, on the ground that it would be a "more dignified course." Dignity and usefulness often appear to stand in inverse relation one to the other. The University does not exist for the sake of being dignified, but of doing work; and the scheme we have elaborated will, if carried out, do work not even proposed by the Conjoint Board. That Board is intended to deal only with such schools for boys as have a governing body, whereas our scheme includes "private adventure" schools both for boys and for girls.

Finally, I may be allowed to express my surprise that NATURE should desire the one University which gives Science its true position to stand aside, and should characterise our wish to assert and to spread its distinctive principles as "cynical."

Hampstead, Feb. 5 H. A. NESBITT

[THE Convocation of the University of London is a very large body, and its proceedings, are reported in the daily papers. A

document which was communicated to every member of that body, and the consideration of which formed part of its proceedings, can only by a legal fiction be described as confidential. But the plea that the document was confidential practically abandons the defence of it. A really statesmanlike paper on a matter which affects all the higher grade schools of the country would gain rather than lose by publicity.

The course which Convocation has under consideration has no doubt, as our correspondents point out, much to be said in its favour. But the reason actually put forward in the preamble of the Report as a ground for taking action, is from the point of view of public policy simply indefensible. It would be appropriate enough if the Report had been addressed by a Board of Directors to the shareholders of a Limited Liability Company, because in the fashion characteristic of such documents it treated the matter in hand from the strictly business point of view of the "concern." It is this attitude which we described as cynical. And we must repeat that it is not in our opinion decorous that a matter gravely affecting the higher education of the country should be treated simply as a question of the falling off of examiners at one particular centre of examination. If it is not the duty of a University to be dignified, it is at least the duty of its advisers to be statesmanlike; and if we may have done injustice to the real desires of the framers of the Report, they have only their own inadequate expression of them to blame.—ED.]

Public Analysts

IN your last week's issue your correspondent, Mr. M. Williams, writes in such terms as would lead your readers to suppose that much less has been done in the matter of butter analysis than is really the case.

I have not the letter before me at this moment, and therefore speak from memory, but I believe that your readers are led to understand that no analyses of pure butter and of pure butter mixed with known quantities of foreign fats have been published. In this he is mistaken, for in a little work published in 1874, the details of eleven experiments upon butters known to be pure are given. The samples were purchased from outlying country farms in the Isle of Wight, and the results of the analyses fairly prove the constancy of the fixed fatty acids in butter.

It is also shown that all foreign fats likely to be used as adulterants are constant in their composition, and that they yield a much larger percentage of fixed acids than does butter; the range of difference being wide enough to offer a practical basis upon which to found accurate estimations of foreign fats in factitious butters. Many admixtures were made, and the published results of the analyses prove the practicability of the method employed. Your correspondent hints that no one dares to undertake the analysis of mixtures of known constitution. I venture to state that if the necessary provisions could be made against concoctions chemically prepared, and so as to admit of commercial admixtures only, such as would be likely to be made use of by fraudulent butter factors, there would be no difficulty in getting half-a-dozen or more analysts ready to take up the gauntlet.

ARTHUR ANGELL

Southampton, Feb. 7

Large Meteors

A LARGE fireball was seen here this evening at about 7.35 P.M. It rolled slowly across the southern sky, and its path was slightly descending from left to right. The observed part of its course was from γ Orionis to a few degrees below α Ceti. There was no train, but the moon was shining brightly at the time, and may have overpowered any faint appendage of this sort. It was many times brighter than Venus (then near setting), and estimated to equal one-fifth the moon's apparent diameter. The globular form of the nucleus was very evident.

A meteor with very slow motion and a short course was observed on Feb. 2, 8.31 P.M., traversing a space between δ Leonis and Cor Caroli, or just above Coma Berenicis. It was as bright as Mars. Radiant point probably near γ Leonis, and very possibly a member of the same system as the fireball described above, which also appears to have been directed from Leo.

A bright meteor was also seen here on Jan. 31, 9.13 P.M. It fell almost vertically in S.S.W. from the Hyades, and must have been quite equal to Venus. I saw it in a region of the sky covered with thin clouds sufficiently dense to obscure the stars. Radiant point probably just north of α Tauri.

Ashley Down, Bristol, Feb. 5 WILLIAM F. DENNING

The Flame of Common Salt

I SEE that it is sometimes permitted to ask questions in NATURE for information. If I might be allowed to do so, I would ask why common salt gives a *blue* light when cast into a fire of coal, and a *yellow* light when burned on the wick of a spirit lamp? The books I have consulted do not give the reason of this.

E. G.

OUR ASTRONOMICAL COLUMN

THE BINARY STAR η CASSIOPEÆ.—Dr. Doberck, of Col. Cooper's Observatory, Markree Castle, has communicated to the Royal Irish Academy the results of a complete discussion of the elements of this binary from the measures to 1875. Though he does not consider the exactness of the orbit to be great, partly owing to the observations being rather unfavourably placed, and partly to uncertainty in the observed distances, the agreement with observation is pretty close, and it appears likely that preference may be given to his elements, over those lately given by Dr. Duner, if the latter are correctly printed. Dr. Doberck's orbit is as follows, being the result of a sixth approximation :—

Peri-astron passage	1909·24
Node	39° 57′
Peri-astron from node	223° 20′
Inclination	53° 50′
Excentricity	0·5763
Semi-axis major	9″·83
Period of revolution	222·435 years.

Combining these values for the semi-axis and length of revolution, with Mr. Otto Struve's parallax (0″·154), we have the following figures :—

Semi-axis major	63·83 earth mean distances.
Mass of system	5·25 sun-masses.

The parallax corresponds to a distance of 1,340,000 times the mean distance of the earth from the sun. The uncertainty attending the measures of distance of the components and the amount of probable error of Mr. O. Struve's value of the parallax, of course allows only of the above figures being regarded as first rough approximations. The semi-axis of the orbit of η Cassiopeæ, it will be seen, results more than twice as great as that of the orbit of Neptune.

The star will doubtless be frequently measured in the present approach to the peri-astron, and every additional five years' observations must be of service in the improvement of the elements.

Dr. Doberck promises an investigation of the orbit of the close binary ω Leonis, no one of the orbits of which star, so far published, represents recent measures. Notwithstanding the case is a troublesome one for calculation, a very fair approximation to the elements should now be practicable.

THE RUGBY (TEMPLE OBSERVATORY) CATALOGUE OF DOUBLE STARS.—Following the excellent plan pursued by Mr. J. Gurney Barclay in the speedy publication of the Leyton measures of double-stars, made by Mr. Talmage with the fine ten-inch refractor of that observatory, Mr. J. M. Wilson and Mr. G. M. Seabroke have given to astronomers (Memoirs, R.A.S., vol. xlii.) a catalogue of micrometrical measures of these objects made at the Temple Observatory of Rugby School during the years 1871-74, with the 8¼-inch Alvan Clark refractor, constructed for the late Rev. W. R. Dawes, used by him in his later measures, and now the principal instrument of the Rugby establishment. Working in this interesting branch of astronomy, in co-operation with Mr. E. Crossley's Observatory near Halifax, Rugby has occupied itself upon the even-numbered stars of Struve's Catalogue below 50° N. declination, Mr. Crossley, with Mr. Gledhill, having employed his 9½-inch refractor upon other stars.

The Dawes-refractor is well spoken of by the Rugby

observers in connection with the work in question, and the measures now published not only confirm this favourable opinion of the instrument, but bear inherent testimony to the care and patience expended on the observations, and will doubtless be received as an important and valuable contribution to double-star astronomy, and especially by those who are occupied with similar observations, or the investigation of the orbits of the binary systems. Amongst the more interesting of the revolving stars, the Catalogue has measures of η Cassiopeæ, 36 Andromedæ, α Geminorum, ζ Cancri, ω Leonis (which difficult object was just divided at the end of March 1873), ξ Ursæ Majoris, γ Virginis, ξ Bootis, η Coronæ, Σ 1938, ζ Herculis, 70 Ophiuchi, Σ 3062, &c. The interesting, though difficult binary Σ 518 (Eridani), is probably within the power of such an instrument, but does not appear in the Catalogue; it may be suggested that it is not too late to examine this object in the present season, the actual angle may probably be found very considerably in advance of that obtained by Prof. Winnecke in 1864, and a first approximation to the form of the orbit may soon be practicable.

JUPITER'S SATELLITES.—If we take a mean of the measures of the diameters of the satellites by Struve at Dorpat, and by Engelmann at Leipsic, we shall have for apparent diameters at the mean distance of the primary :—

I. ... 1″·048 II. ... 0″·911 ... III. 1″·513 ... IV. 1″·278

and with a solar parallax of 8″·875, the true diameters in English miles will be :—

I. ... 2,435 ... II. ... 2,115 ... III. 3,515 ... IV. 2,970

The angular diameters at the centre of Jupiter, are :—

I. ... 31″·4 II. ... 17″·1 III. ... 17″·8 IV. ... 8″·6

and the mean distances from the centre of Jupiter :—

I.	266,700	miles
II.	424,300	„
III.	676,800	„
IV.	1,190,400	„

The diameter of the planet's equator is assumed to be 88,200 miles, as lately given in this column.

THE DRAINAGE OF THE ZUYDER ZEE.

THE Dutch are a people who in many respects command the respect of the world. Their little country possesses comparatively few natural resources, and yet they have made so much of it, and they have been compelled to cultivate the virtues of frugality and industry to such an extent, that the people as a whole are probably better off than those of any other country in the world. Small as the country is, it is only by the exercise of great skill and constant watchfulness that they are able to prevent its being overwhelmed by the German Ocean. In this unfortunately they have not always been successful. Over and over again has the sea burst in upon them, laying waste their dearly-loved country, and sweeping away thousands of the inhabitants. It has only been after many severe lessons that they have learned how to keep the invader back. And within recent years they themselves have taken the offensive, and determined to drive out old Neptune from lands which he has possessed for centuries. Even in the seventeenth and eighteenth centuries they succeeded in draining many small areas of land, and during the present century many marshes and lakes have been brought under cultivation, including Lake Haarlem, upwards of 40,000 acres in extent. In this way about 350 square miles of land, mostly devoted to pasture, have been reclaimed, and that entirely by means of windmills.

Now, however, that the applications of steam-power have reached such perfection, this enterprising people have determined upon an enterprise much more gigantic than any they have hitherto attempted,—nothing less than the drainage of the Zuyder Zee. Until the end of the thirteenth century the area now occupied by that arm of the ocean seems to have been mostly dry land, with a lake in the centre, which by means of a river drained into the German Ocean. At the time mentioned, however, in 1282 according to some authorities, the sea broke through what is now the Strait of Helder, and converted the dry land into a gulf.

For many years the drainage of the Zuyder Zee has occupied the attention of the Dutch Government and of engineers, but it is only since the improvements in the application of steam that the idea has been seriously entertained. At last a scheme has been adopted, after many years' careful research and consideration, for the details of which we are indebted to the French journal *L'Explorateur*.

As early as 1865 a Dutch Credit Foncier Association took up the scheme at the suggestion of Mr. Rochussen, an eminent statesman, and employed two engineers, M. Beijerinck, who drained the Haarlem Lake, and M. Stieltjes. These reported on the practicability of draining the southern, the shallowest and most fertile, half of the inland sea. Soundings were made, and numerous specimens of the bottom brought up, and in short a thorough investigation made from a geological and agronomic point of view. The result of these investigations was most favourable, and the specimens submitted to the analysis of a distinguished agricultural chemist, M. van Bemmelen, having been found to consist of alluvial clay or loam of the first quality and of great depth, over an extent of four-fifths of the bottom of the sea, the Society entered into negotiations with the Government. A Government Commission was appointed to consider the whole question from an economic and scientific point of view, and after an investigation lasting about two years, gave in their report in April, 1868. This report was in favour of granting a concession to the Credit Foncier, whenever that company could present a definite plan that would obviate all existing objections. The Society, after further consideration, requested the Government to delegate a commission of specialists to report further on the scheme, taking into consideration all the interests concerned, and to decide upon the plan best adapted to carry the scheme into execution. After three years thorough consideration the Commission gave in a voluminous report in April 1873, which declared that the project from an engineering point of view was practicable; that the clearing of the new lands would be a difficult and very expensive enterprise, but that the experience acquired and the progress of science would furnish the means of overcoming these difficulties, and of making the enterprise a benefit to the country.

The drainage will be effected in that part of the gulf lying between the provinces of Guelderland, Utrecht, and North Holland, over an extent of 195,300 hectares (about 740 square miles, nearly equal to the area of Surrey, and about 100 miles larger than the Dutch province of Zeeland), by means of a principal dike or embankment, of 40 kilometres in length, 50 metres broad at the base, and raised 5 metres above the ordinary tides, to be constructed from the left bank of the mouth of the Yssel to the island of Urk, and from hence to the town of Enkhuyzen in the province of North Holland. The inclosed area will be divided into squares, and numerous pumping steam-engines will then be set to work, having a collective force of 9,400-horse power. The Commission estimates that the work will be entirely accomplished in sixteen years, and that it will cost a sum of 10,000,000*l.* not including the interest of the capital employed; or 1,600,000*l.* for preparatory works, provisional circular canals, &c., about 2,760,000*l.* for the construction of the dike, and the rest for the purchase of engines, the drainage proper, and the construction of reservoirs, internal canals, roads, railway

lines, and works preparatory to bringing the new lands under culture.

The interest on the above sum will raise it to 13,400,000*l.*, but one-fourth of this will be granted as a subsidy by government, which will be amply compensated by the comparatively enormous addition to its small territory.

Of the 473,000 acres to be drained, four-fifths, as we have said, are of great value, composed as they are of a bed of more than a metre thick of the most fertile mud deposited for centuries by the Yssel and other rivers of which the Zuyder Zee is the receptacle. Only one-fifth consists of land of less value and of sands which will be useful in constructing the base of the dike, or to establish large reservoirs, indispensable in all drainage work, for the reception of the waters until they can be conveyed to the sea. Deduction being made for the land absorbed by these works, by canals, dikes, roads, &c. &c., there will remain upwards of 400,000 acres suitable for culture, and the selling value of which ought considerably to exceed the expenses of the enterprise. Every one must wish that this bold and really beneficent scheme may be carried out with complete success.

THE BIRDS OF NORTH-EASTERN AFRICA[1]

BARON THEODOR VON HEUGLIN is well known as one of the most active and successful of the travellers and naturalists of Germany—one who may fairly rank with the Wallaces and Bates of our own country—as regards the extent of his researches. No man living has devoted more time and toil to the investigation of the Fauna of North-eastern Africa, and as regards the classes of birds and mammals, no man living has a better acquaintance with them. Twelve years passed on the coasts and islands of the Red Sea, in the marshes and jungles of the White Nile, and in the Highlands of Abyssinia, during which time constant attention was devoted to the observation and collection of animals have given Herr von Heuglin unrivalled opportunities for amassing this knowledge, to which his skill as an artist has contributed additional facilities. Soon after returning from his last journey in 1865, Herr von Heuglin planned a general work on the Ornithology of North-eastern Africa to embrace all the notes and observations collected during his different excursions, together with the information acquired by the study of specimens from these countries already existing in the continental museums. In 1869, the first part of the present work was issued, but its large extent hindered its progress, and the author was called away to join the German Expeditions to Nova Zembla and the extreme north, to which he was attached as naturalist. It was not, therefore, until the close of last year, or, we believe we may say until the beginning of the present year, that the concluding part of the Ornithology of North-eastern Africa was issued from the press. Completed, it now forms four volumes, illustrated by fifty-one coloured plates and a map of the region of which it treats, and is by far the most perfect work on the subject hitherto published. Prior to the completion of the present work Rüppell's Atlas, and other publications were, so far as regards Nubia and Abyssinia, the only works of reference, whilst of the district of the White Nile so fully explored by Von Heuglin, very little was known except from fragmentary notices. In the present extended work the ornithology of the whole of these countries, together with that of Egypt, the Red Sea, and Northern Somali-land, are treated of together. The sum of species of birds is thus raised to a high figure, no less than 948, of which upwards of 200 are entirely confined to North-eastern Africa. European species are likewise numerous in these countries, Northern Africa being, as is well known, the favoured haunt of our summer migrants during the winter season. Upwards of 300 European birds thus come to be included in Herr von Heuglin's list. The plan of our author's work is good, though it seems to be rather adapted for the home student than for the field-naturalist, neither family nor generic characters being included. But we observe with pleasure that specific diagnoses are given in Latin to all except the best known species, which, after the contumely that certain imperfectly educated naturalists have recently thought fit to bestow upon that classical tongue, is worthy of all praise. The references to former authors are also numerous, and, so far as we have been able to test them, more accurate than is too often, unfortunately, the case in works of this kind. But the great feature of the book are the observations on the habits and localities extracted from the note-books of the unwearied author. These are much more numerous, and better put together than in almost any other work on foreign ornithology with which we are acquainted. Errors and omissions there are no doubt, and must be, in a work of this magnitude, as indeed is sufficiently evident by the many pages of additions and corrections annexed to the fourth volume, but Herr von Heuglin has spared no trouble to bring his Ornithology of North-eastern Africa up to date, and his volumes will long remain a standard work of reference upon the birds of these districts, which are now attracting so much attention in civilised Europe. P. L. S.

[1] "Ornithologie Nordost-Afrika's, der Nilquellen und Kusten-Gebiete, des Rothen Meeres und des nordlichen Somal-Landes," von M. Th. von Heuglin. In vier Theilen. (Cassel: Fischer, 1869-1874)

FERTILISATION OF FLOWERS BY INSECTS[1]

XIII.

Additional Alpine Flowers adapted to Cross-fertilisation by Lepidoptera.

THE same relation which I have shown to exist between *Daphne Mezereum* and *striata*, *Primula officinalis* and *villosa*, *Rhinanthus crista-galli* and *alpinus* (NATURE, vol. xi. p. 110), exists also between *Viola tricolor*[2] and *calcarata*, the former inhabiting the plain and the lower mountainous localities, and being adapted to cross-fertilisation by bees; the latter, on the contrary, inhabiting the higher Alpine regions, and being adapted to fertilisation by butterflies.

Viola calcarata is found in the Strela pass towards Davos (2,300 metres above the sea-level), and in the rocky slopes of Piz Umbrail towards Quarta Cantoniera (2,600-2,700 m.) in such plenty as to appear from some distance like a blue carpet of flowers. In the latter locality, July 15, 1875, I saw these flowers assiduously visited by different butterflies, of which I caught two specimens of *Colias phicomone*, and three *Erebia laprona E.* (manto, W. V.) The modifications of structure by which the flowers of *V. calcarata* (Fig. 82-85) differ from those of *V. tricolor* (Fig. 15-22, NATURE, vol. ix., p. 46), besides their eminent conspicuousness, so frequently found in Alpine flowers, are such as prevent Diptera and probably also Apidæ from sucking the honey, whereas butterflies, for which alone the honey is reserved, cannot suck it without effecting cross-fertilisation. For the spur, which generally is only 3-4 mm. long in *V. tricolor*, exceeds in this species 10 mm. in length, its width being only 1 mm. in the vertical, and scarcely half a millimetre in the horizontal direction; and the stigmatic knob, provided with a labiated appendage, as in the large-flowered form of *V. tricolor*, lies so closely pressed against the under lip, that no proboscis of any butterfly can enter the spur without grazing the stigmatic lip. The pollen-grains, when they fall out of the anthers, collect in the hairs which clothe the furrow of the under lip (*po* Fig. 85), and no proboscis of a butterfly can be inserted into the spur without being smeared with pollen-grains, which, in the flower next

[1] Continued from vol. xiii., p. 212.

[2] See H. Müller, "Die Befruchtung der Blumen durch Insecten" Leipzig 1873, p. 145, and NATURE, vol. ix. p. 44.

visited, will be partly rubbed off on to the lip of the stigmatic cavity (*l* Fig. 85). All the other contrivances of the flower are nearly the same as in the large-flowered form of *V. tricolor*, described in detail in a previous article (NATURE, vol. ix. p. 47).

It may be worth mentioning that in the lower Alpine localities (for instance, near Valcava, 1,500 m., and near St. Gertrud, Sulden, 1,800 to 1,900 m. above the sea-level) I found a variety of *V. tricolor*, which, as well in the conspicuousness of its flowers as with regard to its fertilisers, is intermediate between the large flowered form of *V. tricolor* (NATURE, vol. ix. p. 46, Fig. 15) and *V. calcarata* (Fig. 82). The flowers of this variety, which is called *alpestris*, are 25-30 mm. long, and 18-22 mm. broad; the three lower petals are yellow near their base, as in our *tricolor* and *calcarata*, marked with black streaks converging towards the entrance of the flower; the two upper petals are very variable in colour, white, or bluish, or yellow, with a large bluish margin. The spur is also

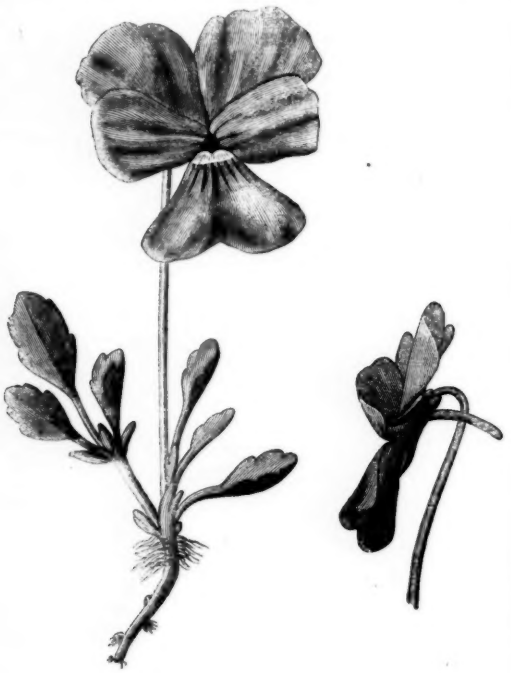


FIG. 82. FIG. 83.

FIG. 82-85.—*Viola calcarata*.[1] FIG. 82.—Whole plant, showing a flower in front, natural size.
FIG. 83.—The same flower, laterally viewed, showing the long slender spur.

variable in length, but on an average remarkably longer than in our *V. tricolor*. I found the flowers of this variety frequently visited by butterflies (*Polyommatus virgaureæ*, L., *P. hippothoë*, L., var. *eurybia*, Ochs., ♂, *Lycaena semiargus*, Rott., *Argynnis pales*, *Hesperia serratulæ*, Ramb.), but only once by a humble bee (*Bombus terrestris*, L., ☿, sucking), whilst our *V. tricolor* is generally

[1] *a* anthers; a^1, upper anther; a^2, insertion of the removed lateral stamen; a^3, lower anther; $a\beta^1$, appendage of the upper sepal; *b*, beard, *i.e.*, tuft of hairs; *cb*, the lateral surface of the stigmatic knob; c^1, $c3$, orange-coloured appendages of the connectives; fi^1, $fi3$, filaments; *k*, knob of the stigma; *l*, lip, labiate appendage of the stigmatic opening; *n*, nectary, *i.e.*, honey-secreting appendage of the lower filaments; *ov*, ovary; *p*, petals; p^1, lower, p^2, lateral, $p3$, upper petal; *po*, pollen-collecting hairs; *pr*, protective hairs (Sprengel's "Saftdecke"); *s*, sepals; s^1, upper sepal (with the appendage $a\beta^1$); s^2, lateral sepal; *sp*. the uppermost part of the spur, containing the honey; *st*. stigmatic cavity; *str*, streaks converging towards the entrance of the flower (Sprengel's "Saftmal"); *sty*, style; *y*, yellow part of the lower petal. (The rest of the corolla is blue.)

visited by *Apidæ*, more rarely by butterflies, and *V. calcarata* exclusively by butterflies. Thus *Viola tricolor*, var. *alpestris* shows us one of the steps by which the common form of this species may have been gradually modified into *V. calcarata*.

Another Alpine flower, remarkable from its conspicuousness and adapted to Lepidoptera, is *Lilium bulbiferum* (Fig. 86-88), which I found on stony slopes of the Schanfick valley, near Chur, in the Spoel Valley, near Zernetz, and, somewhat more frequently, in shelving meadows of the valley of Sulden, beneath the Ortler (1,700-1,800 m. above the sea-level). Although in most points of its structure agreeing with *Lilium Martagon*, described in my article X. (NATURE, vol. xii. p. 50), this flower may be of some interest, because it shows by what slight modifications a sphingophilous species may be adapted to diurnal Lepidoptera, or *vice versâ*. The number and arrangement of the parts of the flower and the structure of the nectary (Figs. 87, 88) are, indeed, the same in *L. bulbiferum* as in *L. Martagon*. That, nevertheless, the latter is cross-fertilised by Sphingidæ, the former by diurnal Lepidoptera, is proved by the following differences:—

1. The flowers of *L. Martagon*, being dark reddish brown, and in the daytime but faintly scented, are only slightly attractive to day-fliers, whilst during the evening

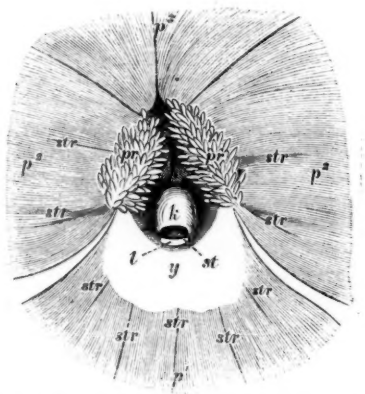


FIG. 84.—Entrance to the flower: seven times natural size.

they emit a very attractive sweet odour. *L. bulbiferum*, on the contrary, by the unusual size of its flowers, with a diameter exceeding 100 mm., and by their colour appearing very splendidly red in the sunshine, is most conspicuous in the daytime, even from a great distance; but being but slightly scented, is incapable of efficaciously attracting night-fliers either by its odour or its colour.

2. The flowers of *L. Martagon* are generally bent downwards, and its sepals and petals reflexed so far as to place the entrances to its nectaries in a nearly horizontal direction, its stamens and pistils projecting downwards, with only their ends slightly bent upwards (Fig. 63, NATURE, vol. xii. p. 50). Thus it affords no landing-place, and offers its honey exclusively to such insects as are capable of inserting a long slender proboscis into the flowers, while they hover in the air by very rapid movements of their wings. *L. bulbiferum*, on the other hand, having its flowers obliquely upright, and offering to their visitors a commodious standing-place on the lowermost petals or sepals, the honey of the lowermost nectaries is accessible to every insect the proboscis of which is long and slender enough to be inserted into the honey-secreting channel.

3. Cross-fertilisation by visiting Sphingidæ is effected in *Lilium Martagon* by the pistil overtopping the anthers, and therefore being first touched by the legs and underside of the visitors, and thus smeared with the pollen of flowers previously visited. In *L. bulbiferum* cross-ferti-

lisation would be prevented if the sepals and petals were as much reflexed as they are in *L. Martagon;* for butterflies would sit down on them and suck the honey out of the channels at their base, without touching the stigma or anthers. But in this species only the ends of the sepals and petals are spread apart, whilst, as far as the sexual organs extend, the leaves of the perianth diverge but so slightly that a butterfly, when inserting its proboscis into the nectary, can scarcely avoid touching the stigma and anthers; and, the pistil being situated nearest to the

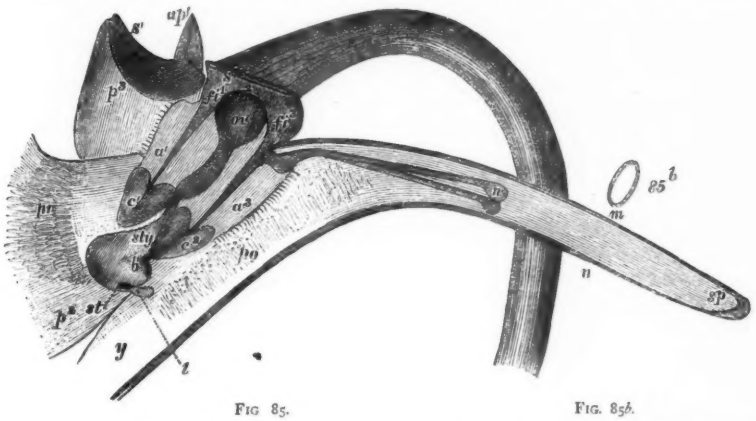


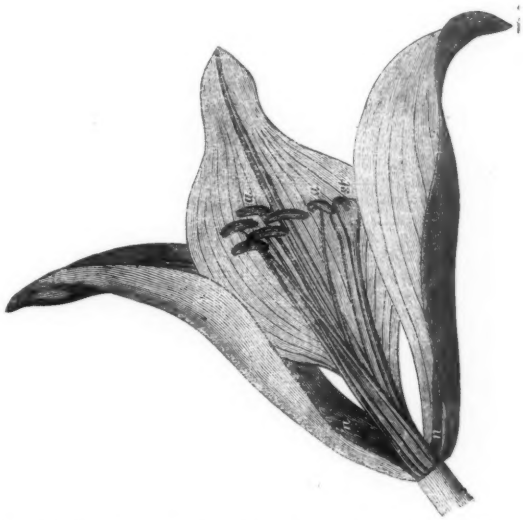
FIG 85. FIG. 85*b*.

FIG. 85.—Lateral view of the flower after the halt of its sepals and petals and one of the two lateral anthers have been removed and the underlip somewhat depressed: seven times natural size. FIG. 85*b*.—Transverse section of the spur, behind the line *m n*, Fig. 85.

lowermost petals and sepals on which the butterflies alight and suck, the stigma here also will be commonly first touched and thus fertilised by pollen-grains of flowers previously visited.

Although, by the contrivances now described *Lilium bulbiferum*, from its very conspicuous flowers, is very likely to be cross-fertilised by butterflies in sunny weather, still in rainy periods many flowers may wither without having received any visit from a butterfly. Hence the possibility of self-fertilisation appears to be indispensable both to *L. bulbiferum* and to *L. Martagon*. In both the anthers and stigma are simultaneously developed to maturity, and are often found in contact with each other; and self-fertilisation may thus be effected in case cross-fertilisation by visiting Lepidoptera is wanting.

4. Direct observation of the visitors proves that *L. Martagon* is really fertilised by Sphingidæ, for instance by *Macroglossa stellatarum*, as observed by myself (see NATURE, vol. xii. p. 50), and by *Sphinx euphorbiæ*, as observed by Federico Delpino;[1] and that *L. bulbiferum* is really fertilised by butterflies, for instance by *Polyommatus virgaureæ*, L., *P. hippothoë*, L., var. *eurybia*, Ochs.,



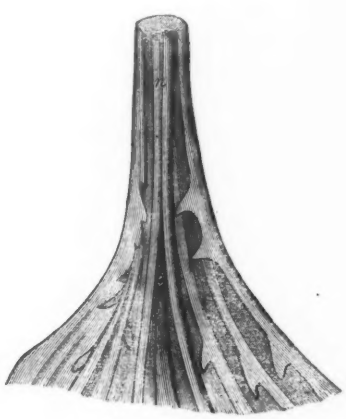


FIG. 86-88.—*Lilium bulbiferum*. FIG. 86.—Lateral view of the flower after the half of the perianth has been removed; natural size. *a*, anthers; *st*, stigma; *n*, nectary.

FIG. 87.—Basal portion of one of the leaves of the perianth. *e*, entrance into the nectary; *n*, nectary: magnified twice.

and *Argynnis aglaia*, L., all of which (July 20, 1875) I found repeatedly in the flowers, not only sucking the honey, but also resting, displaying their wings in the sunshine, and sometimes a male of *Polyommatus virgaureæ*, L., sitting by the side of a female of the same species.

It is a striking fact that all these species of butterflies are of nearly the same splendidly red colour as the flowers they visit. I do not know whether this fondness has been effected by natural selection, agreement of colour

[1] Written to me in a letter of May 1875.

with the flower they sit upon making the butterflies invisible to their pursuers, or if merely the same predilection for a certain colour which has ruled the sexual selection of these butterflies, and by this influenced the colour of their wings, impels them also preferably to visit flowers of their favourite colour; but, from many analogous observations to be published on another occasion, I am strongly inclined to believe that the agreement of colour between the flowers of *L. bulbiferum* and their visitors is not a merely fortuitous one.

Most of the differences between the flowers of *L. Martagon* and *bulbiferum* may be intelligible from the preceding explanation;—still the question remains: What intermediate contrivances are imaginable by which the transformation of a sphingophilous species of Lilium into another one adapted to butterflies could be effected? In this respect it is remarkable that the flowers of *L. Martagon* are not always bent downwards, but sometimes have their axis in a horizontal or somewhat upright position, and that such flowers are now and then also fertilised by day-fliers. Thus, July 19, 1874, near Franzenshöh, I saw a specimen of *Zygæna transalpina*, Esp., visiting the flowers of *L. Martagon*, and inserting its proboscis into the honey-secreting channels; and likewise, July 20, 1875, near St. Gertrud, in the valley of Sulden, a specimen of *Polyommatus hippothoë*, var. *eurybia*, Ochs., behaving in the same manner.

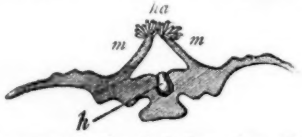


FIG. 88.—Transverse section through the base of one of the leaves of the perianth; seven times natural size. *h*, honey filling up the furrow from which it is secreted; *m*, margins covering the furrow; *ha*, hairs closing the slit between these margins.

HERMANN MÜLLER

SCHOLARSHIPS AND EXAMINATIONS FOR NATURAL SCIENCE AT CAMBRIDGE, 1876.

THE following is a list of the Scholarships and Exhibitions for proficiency in Natural Science to be offered at the several Colleges and for Non-Collegiate Students in Cambridge during the present year:—

Trinity College.—One or more Foundation Scholarships of 100*l.* and one Exhibition of 50*l.* The examination for these will commence on April 18. The Scholarships are open to undergraduates of Trinity College, and persons under twenty who are not yet resident members of the University. The Exhibition is open to persons under twenty, who have not yet commenced residence at the University.

St. John's College.—One of the value of 50*l.* per annum. The examination (in Chemistry, Physics, and Physiology, with Geology, Comparative Anatomy, or Botany) will commence on April 22, and will be open to all persons who have not commenced residence at the University, as well as to all who have entered and have not completed one term of residence. No candidate will be examined in more than three of the above subjects. There is a separate examination in Natural Science at the time of the annual College examination at the end of the academical year, in May; and Exhibitions and Foundation Scholarships will be awarded to students who show an amount of knowledge equivalent to that which in Classics or Mathematics usually gains an Exhibition or Scholarship in the College. In short, Natural Science is on the same footing with Classics and Mathematics, both as regards teaching and rewards.

Christ's College.—One or more in value from 30*l.* to 70*l.*, according to the number and merits of the candidates, tenable for three and a half years, and for three years longer by those who reside during that period at the College. The examination will be on April 4, and will be open to anyone, whether a member of the College or not—provided his name is not on the boards of any other College in the University—who is not of sufficient standing to be admitted *ad titulum Baccalaurei in Artibus*. The candidates may select their own subjects for examination. There are other Exhibitions which are distributed annually among the most deserving students of the College.

Gonville and Caius College.—One of the value of 60*l.* per annum. The examination will be on April 4, in Chemistry and Physics, and Zoology with Comparative Anatomy and Physiology; it will be open to students who intend to commence residence in October, and are under twenty. Further information may be obtained from the Tutors.—Scholarships of the value of 20*l.* each or more are offered annually for Anatomy and Physiology to members of the College.

There will be an examination on the 4th of April, 1876, in Botany and Comparative Anatomy in its most general sense (including Zootomy and Comparative Physiology), for two *Shuttleworth Scholarships*, each of the value of 60*l.* per annum, and tenable for three years. The candidates must be registered medical students of the University who have kept eight terms, have passed the Additional Examination required for Candidates for Honours, and produce satisfactory testimonials of good conduct. A successful candidate, if not a member of Gonville and Caius College, must become a member of the same. They are tenable with any other Scholarship at the College.

Gentlemen elected to the *Tancred Medical Studentships* are required to enter at this College; these Studentships are five in number, and the annual value of each is 100*l.* Information respecting these may be obtained from B. J. L. Frere, Esq., 28, Lincoln's Inn Fields, London.

Clare College.—One of the value of 60*l.* per annum, tenable for two years at least. The examination (in Chemistry, Chemical Physics, Zoology with Comparative Anatomy and Physiology, Botany with Vegetable Anatomy and Physiology, and Geology) will be on March 28th, and will be open to students intending to begin residence in October.

Downing College.—One or more of the value of 60*l.* per annum. The examination (in Chemistry, Comparative Anatomy and Physiology) will be on, or about, April 25, and will be open to all students not members of the University, as well as to all undergraduates in their first term.

Sidney College.—One of the value of 60*l.* The examination will be on April 4, and will be open to all students who intend to commence residence in October.

Emmanuel College.—One of the value of 70*l.* The examination on April 4, in Botany, Chemistry, Chemical Physics, Geology and Mineralogy, Zoology, Comparative Anatomy and Physiology, will be open to students who have not commenced residence.

Non-Collegiate Students.—An Exhibition each year is given by the Clothworkers Company, value 50*l.* per annum, tenable for three years. Examination about Christmas, open to non-collegiate students who have commenced residence in the October term, and to any who have not commenced residence. Information to be obtained from the Rev. R. B. Somerset, Cambridge.

Although several subjects for examination are in each instance given, this is rather to afford the option of one or more to the candidates than to induce them to present a superficial knowledge of several.

Candidates, especially those who are not members of the University, will, in most instances, be required to show a fair knowledge of Classics and Mathematics, such, for example, as would enable them to pass the previous examination.

There is no restriction on the ground of religious denominations in the case of these or any of the Scholarships or Exhibitions in the Colleges or in the University.

Further information may be obtained from the Tutors of the respective Colleges, and the names, with certificates of character, date of birth, &c., must be sent to the Tutor of the College, in each case, several days before the examination.

Some of the Colleges do not restrict themselves to the number of Scholarships here mentioned, but will give additional Scholarships if candidates of superior merit present themselves; and other Colleges than those here mentioned, though they do not offer Scholarships, are in the habit of rewarding deserving students of Natural Science.

It may be added that Trinity College will give a Fellowship for Natural Science, once, at least, in three years; and that most of the colleges are understood to be willing to award Fellowships for merit in Natural Science equivalent to that for which they are in the habit of giving them for Classics and Mathematics.

THE INDUSTRIAL APPLICATIONS OF OXYGEN[1]

LAVOISIER, who was the first to recognise in its widest range the importance of oxygen, was also the first who succeeded in making a practical use of it. "It is evident," he writes,[2] "that atmospheric air is not the best calculated means to increase the effect of fire; for, when a volume of air is conveyed through the bellows to red-hot coals, three (?) parts of noxious or at least useless gas are conveyed with every one part of the useful kind of air; consequently, if the latter could be employed for combustion in its pure state, the action of the fire would be greatly increased. Doubtless this idea has occurred to many others before me; indeed, I hear that M. Achard[3] has already tried the experiment, but as yet a cheap and convenient apparatus is wanting." Lavoisier first used the bladders of animals, which were provided with cocks and tubes. "Then," continued he, "I made a hole with a knife from three to four lines deep in a large piece of charcoal and placed in it six grs. of platinum. I then ignited the charcoal through the blowpipe communicating with the enamel lamp, uncocked my apparatus, and blew the pure vital air into the cavity. The coal burnt very rapidly with detonation (such as is produced by fusing saltpetre) and with dazzling brightness; in a few moments the platinum was fused to grains, which soon united into a drop. The fusion was effected equally well when using commercial platinum as when using that, which had been deprived of its magnetic parts by the magnet. Hitherto, it is well known, platinum had been considered infusible." In the course of the same year Lavoisier[4] improved his apparatus with the assistance of Meusnier, and soon became possessed of a gasometer consisting of two boxes greatly resembling, on a small scale, the well-known reservoirs used in gasworks for holding coal-gas. About the same time Saron had constructed two blow-pipes (*chalumeaux*), one to furnish oxygen, and the other hydrogen gas.

By their help Lavoisier did not succeed in melting platinum.[5] However, at that time he and Saron had conceived the idea of constructing an improved blow-pipe, in which the oxygen should surround the hydrogen, and this led to the contrivance of the oxyhydrogen blow-pipe, which has ever since been of such substantial service in the working of platinum and the soldering of lead.

No further attempts were made to fuse platinum by means of oxygen until Deville and Debray[6] in 1857-1859 and the years following, published their excellent researches "On the platinum metals," and brought the fusion of platinum into practice. The soldering of platinum with platinum, and the manufacturing of cast bars, were carried on on a large scale, first by Messrs. Johnson, Matthey, and Co., in London, and afterwards, though on a smaller scale, by Heræus in Hanau. The experiments of Debray and Deville were attended with one especial result, the discovery of a fire-proof material for making furnaces and crucibles. This is quick-lime, which had the further advantage of retaining the heat as completely as possible. Besides, the temperature was increased by conducting the flame from above, directly, to the surface of the metal, and regulating the quantity of oxygen and hydrogen as theory and practice suggested it. To melt 2 kilogs. of platinum, theory demands 55 litres oxygen and 110 litres hydrogen, while in reality more than one kilog. is fused by these quantities, so that not 50 per cent. of the generated heat is lost (a very satisfactory result). Their experiments were of still greater importance for the history of oxygen industry, inasmuch as they gave occasion for comparing the prices of different modes of preparing it, and stimulated inquiry after cheaper processes. These we may divide into chemical and mechanical, subdividing the former again into continuous and intermittent processes. Up to this time the following modes of preparation were in use, or had been proposed. To begin with the oldest method of Priestley, heating oxide of mercury, unquestionably the most costly and the least adapted for practical purposes; then Scheele's method, treating peroxide of manganese with sulphuric acid, which produces sulphate of manganese and oxygen. Through Berthier's researches in 1822, this process has been superseded for manufacturing purposes by heating peroxide of manganese; and, lastly, we have to mention Bertholet's method, the heating of chlorate of potassium. Notwithstanding its cost, the latter is constantly used in the laboratory, because it is easy and requires little heat, although it not unfrequently happens that a too rapid fusion causes explosions. To obviate this inconvenience, the suggestion has repeatedly been made of mixing peroxide of manganese with the chlorate of potassium.

More recent accidents, especially a fearful explosion which took place in a pharmaceutical laboratory in Paris, induced Debray and Bourgoin[1] to publish the precautions taken in Deville's laboratory: peroxide of manganese, or what is easier to obtain in a pure state, red oxide, Mn_3O_4, is added to the chlorate of potassium in equal quantities, and the iron vessel containing it exposed to heat in a charcoal furnace, so that the fire is lighted from above. Schwartz[2] also gives an account of some accidents occasioned by using peroxide of manganese adulterated with lampblack, and by inadvertence, even with sulphuret of antimony; and for that reason he recommends that all mixtures for the production of oxygen be first tried by heating them on a sheet of platinum. Munck[3] proposed adding oxide of iron, which is more easily recognised, instead of peroxide of manganese. Scheele's method of using peroxide of manganese and sulphuric acid had this disadvantage: the glass vessels employed were very liable to burst, through the solidifying of the sulphate of manganese. To prevent this, R. Wagner[4] proposed to substitute bisulphate of sodium for sulphuric acid, thus forming an easily fusible double salt, which would afford no danger of breaking the retort when cooling. Pure peroxide of manganese yields 18 per cent. by this treatment, while heating it to red heat, which resolves it into sesquioxide, yields only 12 per cent. of oxygen; nevertheless, the last method is the cheapest. Deville and Debray[5] calculates its expense in proportion to the prices of peroxide of manganese, which are as follows:—

	Per 100 kilogs.	Per 1 cb.m.
Romanèche	10 francs	4·86 francs
Spain	16 „	3·45 „
Pyrenees	18 „	3·85 „
Giessen	29 „	4·87 „
Italy	40 „	5·98 „

The trifling value of the remaining sesquioxide, which (containing iron) is of no use in the manufacture of glass, is not here considered.

The calculation dates from the time when the regeneration of peroxide of manganese was an unsolved problem. Allowing therefore the price of oxygen obtained from peroxide of manganese to vary between 3·45 and 5·98 fr., it is more than twice as cheap as that which is procured from chlorate of potassium, for which, according to Dupré,[6] the average price is 10 fr.

As a much cheaper source, Deville and Debray now had recourse to sulphuric acid, which at a high temperature is decomposed into water, sulphurous anhydride, and oxygen.[7] Retorts of hard glass of a capacity of 5 litres are filled partly with thin layers of platinum-foil or bits of tile and heated to a red heat, whilst a thin stream of sulphuric acid is introduced.

The escaping gases pass through a cooling contrivance to condense the sulphuric acid, and afterwards through water to remove the sulphurous acid gas. Thus, out of 2·435 kilogs. of sulphuric acid of spec. grav. 1·827, 240 litres of oxygen were obtained, and the price was calculated at 1 fr. per cb.m. By

[1] Translated, by permission of the editor, from the Report on the Development of Chemical Industry, in conjunction with friends and fellow-workers, by A. W. Hofmann.

[2] "Mémoire sur un moyen d'augmenter considérablement l'action du feu et de la chaleur dans les opérations chimiques" (1782). Œuvres de Lavoisier, ii., 425.

[3] The above-mentioned work of Achard is to be found in the Memoirs of the Berlin Academy of 1779, under the title, "Sur un nouveau moyen de produire avec une très-petite quantité de charbons une chaleur égale a celle qu'on peut produire par des verres et des miroirs ardents d'une grandeur considérable." Achard decomposed saltpetre by heat in an earthenware retort, and introduced the "dephlogisticated air" thus obtained into a pair of bellows, from whence it was conveyed into a charcoal furnace, where some iron nails in a hessian crucible were rapidly reduced to fusion. He was also of opinion that the introduction into badly ventilated rooms of gas procured in this way would cause the air in the same to be "dephlogisticated."

[4] Lavoisier, Œuvres ii., 432.

[5] Lavoisier, Œuvres ii., 430.

[6] Deville and Debray, 1859, Ann. Chim. Phys. [3] lvi. 385; Dingl. pol. J. cliv., 130, 199, 287, 383; in abstract Ann. Chem. Pharm. cxiv. 78, and Debray, "Sur la production des températures élevées et sur la fusion du platine," in the "Leçons de Chimie professeés en 1861." Paris, Hachette, 1862.

[1] Debray and Bourgoin, Ber. Chem. Ges., 1870; 240.

[2] Schwartz, "Breslauer Gewerbeblatt," 1865, No. 7; Polzt Centralbl., 1865, 12.

[3] Munck, Pohl's Lehrb. d. Tecknol., Wien, 1865; 186.

[4] Wagner, Jahresber., 1866; 198.

[5] Deville and Debray, Compt. Rend., li. 822; Dingl. pol. J., clix., 50.

[6] Dupré, Compt. Rend. lv. 736.

[7] Deville and Debray, Compt. Rend. li. 822; Dingl. pol. J. clix. 50, in Ausz. Ann. Chem. Pharm. cxvii. 295.

this process the cost of melting 1 kilog. of platinum was reduced to 20 or 30 centimes. According to a notice of Moigno,[1] the firm of José de Susini and Co., in Paris, in the year 1867 prepared oxygen in this way at the low price of 0·85 fr. per cb.m., retransforming sulphurous into sulphuric acid. Instead of the acid itself, Deville and Debray also proposed employing sulphate of zinc: 100 kg. of anhydrous salt yielded them 6·8 cb.m. of oxygen (far more therefore than the best peroxide of manganese), 22 kilogs. of sulphurous acid gas, and 51 kilogs. of oxide of zinc.

Wagner's statement[2] is worthy of remark, that in the year 1867 neither of these methods was in use in Deville's own laboratory; perhaps because the sulphurous acid evolved complicated the working.

We must not pass over Archereau's attempt[3] to employ sulphuric acid in its cheapest combination as gypsum. He asserted that heating pulverised gypsum with sand would produce silicate of calcium, setting sulphurous acid free, which he partly condensed (as did also Susini) under a pressure of three atmospheres, and partly removed by means of a thin paste of lime. A manufactory established on these principles in Paris did not work long.[4] Obviously the very high temperature required is an obstacle. The production of this gas from one of the oldest of all oxidising agents, saltpetre, was not employed on account of two drawbacks. In the first place, a quantity of nitrogen is mixed with it; and secondly, the temperature necessary for its decomposition greatly increases the cost. This last inconvenience was remedied by Webster's[5] adding oxide of zinc to saltpetre: 20 lbs. of nitrate of soda and 4 lbs. of crude oxide of zinc furnished 94·676 cubic feet of a mixture of 59 p. c. of oxygen and 41 p. c. of nitrogen, while chiefly oxide of zinc and caustic soda remained. The price of the oxygen contained in this mixture, so useful for many purposes, without taking into consideration the value of the solid residue, amounts[6] to 2·32; and allowing for the value of the remains, the price is reduced to 0·78 fr.

In no one of these methods appears one of the leading ideas of modern industry, viz., the regeneration of the residues.

The following plans were happier in this respect, and thereby, in part, more successful.

To combine chemically the oxygen of the air with a carrier of oxygen that would easily give off the gas, and would be always ready to take up and again to give off fresh quantities of oxygen, just as mercury does when we transform it into its oxide and retransform the oxide into the metallic state—that is the problem of which the last few years have given an economical solution. As early as 1829 Dingler jun.[7] discovered that oxide of copper as well as peroxide of cobalt and nickel, treated with an excess of chloride of lime, generate oxygen gas, thereby transforming it into chloride of calcium. In the year 1845 Mitscherlich[8] observed that many other metallic oxides, viz. peroxide of manganese, hydrate of ferric oxide, cupric oxide, &c., when added to a solution of chloride of lime, caused a development of pure oxygen. In 1865, Th. Fleitman[9] renewed these observations with reference to freshly prepared sesquioxide of cobalt, the smallest trace of which was sufficient completely to reduce a concentrated solution of chloride of lime into chloride of calcium and oxygen. For practical purposes he recommended to heat to 70° or 80° a highly concentrated solution of chloride of lime (which to avoid frothing over should be previously cleared by filtration) with 0·1 to 0·5 per cent. of sesquioxide of cobalt. By applying chloride of lime containing 35 per cent. of pure hypochlorite, he obtained from twenty to thirty volumes of oxygen in a regular stream; and other observers, notably F. Varrentrapp,[10] confirmed these results, and commended their industrial application. The sesquioxide of cobalt need not be added ready formed; any cobalt salt answers the same purpose, and the sesquioxide employed with or formed by it soon settles at the bottom and can be used again and again.

For that very reason a cheaper oxide—cupric oxide, for instance, as Böttger[11] proposed—would be of trifling advantage, because its use demands[12] a much higher temperature for decomposition. The tedious work of preparing a clear solution of chloride of lime may be avoided by adding[1] small morsels of paraffin, a thin layer of oil on the surface preventing an overflow. There was still one evil to be grappled with. Chloride of lime requires considerable quantities of water for its solution, and consequently large vessels were necessary for the production of even a moderate quantity of oxygen. For that reason a Winkler[2] rejected chloride of lime, preferring to pass chlorine through a thin paste of lime mixed with a little nitrate of cobalt. By this modification a greater quantity of oxygen can be produced in the same vessel, and there is no danger of the liquid frothing over. The part which the metallic oxide plays in these methods is easy to understand. It acts as a carrier of oxygen, passing by turns into a higher and very unstable oxide, and being reproduced in its original state. The hypochlorous acid transforms sesquioxide of cobalt into cobaltic acid, which instantly separates again into oxygen and sesquioxide of cobalt.

$$Co_2O_3 + 3\,[CaCl(OCl)] = 3CaCl_2 + 2CoO_3$$
$$2CoO_3 = Co_2O_3 + O_3.$$

Thus, part of our problem is solved. By the production of oxygen the carrier of oxygen is reproduced. The oxygen, however, thus obtained is not taken from the atmosphere, but from lime. The solution of chloride of calcium resulting from its preparation must be removed and replaced by fresh lime water. The process is therefore an interrupted one, and in this respect capable of economical improvements. These also have been accomplished by methods which carry us back from the wet to the dry way.

Since 1851[3] Boussingault proposed baryta as a carrier of oxygen, which, heated to redness in a porcelain tube and treated with moist air previously freed from carbonic acid, became transformed into peroxide of barium. A current of steam passing over it reproduces hydrate of barium and liberates the oxygen; while an admixture of lime or magnesia prevents the fusing together of the mass, and thus 75 gr. of baryta yield 4 to 5 lit. of oxygen at every operation.

In 1868 Gondolo[4] improved on this method by employing iron tubes protected by an outside covering of asbestos and by an inside layer of magnesia, and placed in suitable furnaces, the temperature of which could be easily regulated. He further added to the baryta a little manganate of potassium as well as lime and magnesia. In this manner 122 alternate oxidations and reductions were carried on in the same tube. Whether it be the high temperature or other obstacles which have prevented this method from being generally adopted, it has certainly made no way as yet into practice, although it has paved the way to final success.[5] Looking for carriers of oxygen of a more useful sort than baryta, the chlorides of copper were the first to strike the attention of chemists. The facility with which they pass into oxychlorides of various compositions when exposed to the air, is the base of the manufacture of a well-known painter's colour, Brunswick green. In 1855 Vogel proposed the action of muriatic acid on cupric oxychlorides as a means of obtaining chlorine.[6] Mallet[7] studied these substances more closely, and founded on them a process of obtaining both chlorine and oxygen. He discovered that cupric chloride, treated with a current of steam, changes at 100° to 200° into several oxychlorides, which, by means of muriatic acid, are not only at once retransformed into the chloride and free chlorine gas, but give off all oxygen at a temperature of only 400°, 1 kilog. of cupric chloride yielding from 28 to 30 lit. of oxygen. Experiments on a large scale produced from 3 to 3½ cb.m. of oxygen, or from 6 to 7 cb.m. of chlorine, from 100 kilogs. of chloride of copper in one operation. As four or five operations can be performed in one day, from 200 kilogs. of cupric oxychloride 15 to 18 cb.m. of oxygen are producible daily.

The apparatus employed consists of revolving retorts of cast-iron lined with clay, and containing the cupric chloride mixed with ⅓ of sand or kaolin to render the mass less fusible. This

1 Moigno, Mondes 1867; p. 494. 2 Wagner, Jahresber., 1867, 216.
3 Archereau, Dingl. pol. J. clxxviii. 57. 4 Wagner, Jahresber., 1867; 215.
5 Pepper, "Chemical News," 1862; 218.
6 Dupré, Compt. Rend. lv. 736. 7 Dingl. pol. J. xxvi. 231.
8 Mitscherlich, Pogg Ann. lviii. 471.
9 Fleitman, Ann. Chem. Pharm. cxxxiv. 64.
10 Varrentrapp, "Mittheilungen f. d. Gewerbe verein der Herzogthumas," Braunschweig, 1865, 1866; 72.
11 Böttger, J. pr. Chem., xcv., 375.
12 Reinsch, N. Jahrb. Pharm., xxiv., 94; Zeitschr. Chem., 1866, 31.

1 Stolba, J. pr. Chem., xcvii., 309.
2 A. Winkler, J. pr. Chem., xcviii., 340.
3 Boussingault, Compt. Rend. xxxii. 261 et 821; J. pr. Chem. lii. 480 u liii. 313; Dingl. pol. J. cxx. 120 u. 416; Ann. Chim. Phys. [3] xxxv. 5.
4 Gondolo, Compt. Rend., lxvi., 488.
5 Robbin (Pogg. Ann., cxxii., 256) employed peroxide of barium in another form for laboratory use. He recommends a mixture of chromate of potassium (1 mol.) and peroxide of barium (3 mol.) with dilute sulphuric acid, to obtain a very regular and abundant supply of oxygen:—
$$2CrO_3 + 3H_2O_2 = Cr_2O_3 + 3H_2O + 6O.$$
6 Vogel, Wagn. Jahresber., 1861, 177.
7 Mallet, Compt. Rend. lxiv. 286, u. lxvi. 349.

method was employed at Cologne in 1871.[1] A company formed in Paris for its employment had but a very brief existence,[2] probably owing to a similar discovery which soon supplanted the one described above.

This method, originated and perfected since 1867,[3] by the inventive powers of M. Tessié du Motay, employs peroxide of manganese as the carrier of oxygen, and takes its stand upon the following reactions. Sodic hydrate exposed to dark red heat with manganese and air, yields, as Mitscherlich discovered, manganate of sodium and water, $4NaOH + 2MnO_2 + 2O = 2\ Na_2MnO_4 + 2H_2O$; and manganate of sodium, under the influence of a dry current of overheated steam, disengages at the same temperature sodic hydrate, manganic sesquioxide, and free oxygen, $2Na_2MnO_4 + 2H_2O = 4NaOH + Mn_2O_3 + 3O$. By previously depriving the overheated air of its carbonic acid, one may preserve the mixture in a perpetually active state. This method has been thoroughly tested and approved, and has since been employed on a large scale in Comines, near Lille; in Pantin, near Paris; in New York, in Brussels, and in Vienna. Bothe [4] informs us that a mixture of sixty parts of dry carbonate of sodium with forty parts of 95 per cent. peroxide of manganese, when fused, contains 74·62 parts of manganate of sodium, and that 40 kilogs. of this mixture, which, according to calculation, should give 2,036 cb.m. of oxygen gas, produced in reality 1,800 cb.m., or 90 per cent. of the theoretical yield. He recommends the proceeding as a very practical one. M. Pourcel [5] has given us the most detailed description. According to him, M. Tessié du Motay employs cast-iron ellipsoidal retorts, which lie horizontally one beside the other, and are divided by a grating parallel to their axes, into two unequal parts. Over the grating 350 kilogs. of manganate of sodium, or of the reduced mixture of manganese and soda, are so spread out that its height amounts to 0·60 m., and the empty space above and below the mass is as inconsiderable as possible. In Comines, where five of these retorts are used, the amount of oxygen produced daily is 140 cb.m. at the cost of 450 kilogs. of coals for heating the retorts, and of 150 kilogs. used for the steam-engine. The air is passed through a thin iron vessel with quick-lime by means of the bellows, under a pressure of from 3 to 4 cm. of mercury, and enters the retort from above. The temperature of the latter can be observed through a hole provided with an iron stopper. In this way the air gives off only about half of its oxygen, so that to produce 1 vol. of oxygen 10 vol. of air must be passed through, the remainder escaping into the atmosphere. Five minutes suffice for oxidising the reduced mass. The current of air is then interrupted by means of a three-way stopcock and superheated steam passed through the retorts for five minutes, while the gas, passing out below the grating, enters condensers. Here a fine rain of cold water frees the oxygen from the steam, and the gas enters the gasometer under the pressure of a column of water of from 8 to 10 cm. in height. Thus reduction and oxidation alternate at intervals of five minutes. After a lapse of six hours only, it is necessary, for a perfect regeneration of the fused mass, to admit atmospheric air for about an hour, because the quantity of oxygen obtained becomes lowered after five or six hours, down to half or even a third part of the original quantity. In Vienna the cocks are worked by an automatic apparatus. The longer the steam is forced in and the retorts freed from air before the communication with the gasometer is opened, the purer will be the oxygen; half a minute is enough to leave only 15 per cent. of nitrogen mixed with it, provided the injurious space in the retort be kept as small as possible. If the nitrogen be lowered to 4 per cent., which is easily effected, the sacrifice of oxygen will be so much the greater. To make certain that the quantity of nitrogen remains within the limits of 15 and 10 per cent., which are proved to be the most practicable, gas is taken from the gasometer or the condenser in graduated tubes, and the oxygen is absorbed by means of pyrogallate of potassium, a reaction attended by quick and sure results, even in unpractised hands.

As every cooling down of the retort below dark red heat lessens the yield, care is necessary to raise the temperature of the air, as well as of the steam, to about 300° C. In Pantin, where several groups of ten retorts are set up, two of them are filled with pumice-stone to warm the air and the steam. The composition of the fused mass corresponds to 2 mol. NaOH, 1 mol. MnO_2, and the fifth part of a mol. of cupric oxide, which serves only to disintegrate the mass and make it more accessible to the influence of the air and steam. In Comines peroxide of manganese is reproduced from the residues of chlorine by the known methods, almost in a pure state. Its market-price, for which the Pantin works buy it, amounts to 2 fr. per kilog. The high price of this basis of the manufacture of oxygen is indifferent, as it can be used continuously, and the longer, the more carefully the air is kept free from carbonic acid. If, through some unavoidable interruption of the manufactory, the mass should have attracted carbonic acid from the atmosphere, it suffices to bring it to a red heat, and pass steam over it until the steam, on leaving the retorts, produces no precipitates in lime-water: then hot air passed over it will restore the mass to its original efficiency. On an average, a retort is said to last about a year.

M. Tessié du Motay's method produces a cubic metre of 90 per cent. of oxgyen for 15 to 30 centimes,[1] or, according to the results of Herr Kuppelwieser's experiments,[2] 1,000 cubic feet at 3 fr., a price in accordance with the last-mentioned sum, and scarcely exceeding that of coal-gas. We may regard this method as a final and successful solution of the problem of discovering economical and rational chemical means for obtaining oxygen.

(*To be continued.*)

1 Philipps, "Der Sauerstoff," Berlin, 1871, 22.
2 Wagn. Jahresber., 1867, 215.
3 Tessié du Motay, Institut 1868, 48.
4 Bothe, Zeitschr. d. Vereins deutch. Ing., 1867, 334.
5 Pourcel, "Mémoires de la Société des Ingénieurs Civils." Paris, 1873.

1 Philipps, "Der Sauerstoff," 18.
2 Kuppelwieser, Berg-u. Hütten. Zeitung, 1873, 354.

NOTES

THE Wollaston Medal of the Geological Society has been awarded to Prof. Huxley, and will be presented at the Anniversary of the Society on the 18th inst. Prof. Huxley has also been elected a Corresponding Member of the Danish Academy of Sciences.

THE *Times* of yesterday contains a summary account of what has been done so far in this and foreign countries towards organising the Loan Collection of Scientific Instruments to be opened at South Kensington in April. The invitation from the Science and Art Department has met with a hearty response both in this country and from foreign Governments. We last week gave a list of the Foreign Committees, and the *Times* publishes the list of those on the English Committees in the various departments of Mechanics, Physics, Chemistry, Geology, and Biology; and as the *Times* remarks: "By going over them not only does one get an idea of the disinterested way in which men—for the most part busy men—have come forward to help the Department, but there can be no better guarantee of the success of the Exhibition than that afforded by the list of those who are labouring to make it successful." It would indeed be difficult to mention any man of scientific eminence in this country whose name is not included in the list. Out of England, as our readers would see from last week's list, the most numerous committee is the German one. On this the *Times* says:—"The German list gives us much food for thought. It is known, for instance, that the thirty-four local committees, representing her many Universities, Polytechnic Schools, and other scientific centres, were all organised in a week, and that her Universities will, in all probability, be the richest contributors, whereas when we have mentioned Edinburgh, Glasgow, Manchester, Birmingham, Leeds, and Liverpool, and perhaps Newcastle, we have almost exhausted the localities where committees would be useful." The teaching side of the collection will be complete beyond all anticipation. The Physical Cabinet, it is stated, will be such as the world has never seen, towards the formation of which not only will British, French, German, Italian, and Austrian instrument makers lend their aid, but the collections of the Royal Institution, Glasgow University, Edinburgh University, King's College, the Conservatoire des Arts et Métiers, the College de France, the Universities of Berlin, Bonn, Heidelberg, Leipsic, Vienna, Rome, and Leyden, and the Tayler Institution at Haarlem, and the like, will be ransacked. The Chemical and Historical Collections will be of scarcely less magnitude. With regard to the last it is still doubtful whether Italy will part with Galileo's telescope and magnet, even for a month, though it is

hoped that some of the numerous instruments left behind by Torricelli, Volta, and Galvani, may yet be obtained. Besides instruments which are sacred as having belonged to the pioneers of science, others with which the greatest investigators of modern times have made their famous discoveries will have their place in the Exhibition. The *Times* article concludes :—"The scientific position of England has been distinctly raised by this step on the part of our Government, and the Lord President is to be congratulated on a step which not only adds reputation to his Department, but promises to aid so greatly the cause of scientific instruction throughout the land."

UNDER the direction of Prof. Todaro, the biological department in the University of Rome has recently been exhibiting great activity. Prof. Todaro himself has published during the last two or three years a number of important papers, including a monograph upon the development of Salpa. There has also appeared a volume entitled "Recerche nel Laboratorio de Anatomia della Universita de Roma," which contains a number of valuable contributions both by Prof. Todaro and his pupils. Considering the vigour which is being displayed by the anatomists at Rome, it is much to be regretted that the University of the capital of Italy supplies, for biological purposes, accommodation of the most meagre kind.

MR. HERBERT SPENCER has been elected a Corresponding Fellow of the Royal Academy of Rome.

THE first and second Cambridge Smith's Mathematical Prizes have been awarded respectively to Mr. J. T. Ward and Mr. W. L. Mollison, the Senior and Second Wrangler.

AT the last sitting of the Lisbon Royal Academy of Science, the members passed a resolution expressing their appreciation of Lieut. Cameron's labours in traversing the African continent from east to west. A copy of this resolution will be transmitted to Lieut. Cameron. At the same sitting Mr. Bowdler Sharp and Father Secchi were elected Corresponding Associates of the Academy.

ON Monday next, Feb. 14, Prof. Flower will commence an important course of nine Hunterian Lectures at the Royal College of Surgeons, Lincoln's Inn, to be given on Mondays, Wednesdays, and Fridays, upon "The Relation of Extinct to Existing Mammalia, with special reference to the Derivative Hypothesis." This course is a continuation of that of 1873, which we were enabled to report shortly at the time. The discoveries since that year among the *Monotremata*, *Edentata*, *and Ungulata* will be described, as well as the American extinct Perissodactylates and Arteodactylates. Among the most interesting features of the course will be the account of the extinct aberrant Ungulate, *Uintatherium*, and the quasi-proboscidians of North America, also of *Toxodon* and *Nesodon*. The fossil Sirenia, including *Halitherium*; the Cetacea, Pinniped Carnivora, Fissiped Carnivora; Tillodontia, Insectivora and Cheiroptera, Rodentia and Primates will also be included. The lectures will be fully illustrated by specimens from the Museum, and by diagrams. We shall have the opportunity of giving fairly full abstracts of these lectures, one each week—the first in our next issue.

M. CAZIN sends an interesting note to the last number of the *Bulletin International*. It seems that M. G. Loppé, the glacier painter, well known to all Alpine tourists, and Mr. James Eccles, of London, attempted on January 20 last the ascent of Mont Blanc. They were only able to reach the Grand Plateau; the wind raised thick clouds of snow dust, which threatened to bury the party. Thermometric observations were made, and they show that the temperature varies little in the high Alpine regions. The lowest temperature (– 13°) observed on the Grand Plateau (3,932 metres) is no lower than the temperatures observed in the same place during summer. The provisions—meat, bread, wine, tea—were frozen, and the wind made the cold insupportable. The following are the temperatures observed during the ascent and at Chamounix :—

ON THE MOUNTAIN.

Jan. 19.	Junction of the glaciers,	2,600 metres,	4.30 P.M.	–	5°·5
,, ,,	Grand Mulets ...	3,050 ,,	8.30 ,,	–	7
,, 20	,, ,, ...	,, ,,	2 A.M.	–	7
,, ,,	Small Plateau ...	3,635 ,,	8.30 ,,	–	12·5
,, ,,	Grand Plateau ...	3,932 ,,	9.30 ,,	–	13
,, ,,	Grand Mulets ...	3,050 ,,	1 P.M.	–	8·5

At Chamounix the temperature on Jan. 20 at 7 A.M. was – 11°, at 8 A.M. – 10°, at 10 A.M. – 9°, at 11 A.M. – 8°. The sun began to appear at 11.30.

AT a meeting of the Edinburgh Medico-Chirurgical Society, held on Monday, Jan. 31, Dr. Matthews Duncan read a paper on the alleged epidemic character of erysipelas and puerperal fever. From an elaborate set of diagrams showing the weekly and yearly deaths registered in London from 1848 to 1875, it was pointed out that during the whole of this time erysipelas and puerperal fever have on no occasion exhibited any approach in their death-rate to such diseases as cholera, small-pox, and scarlet-fever, allowed by all to be epidemic in their character, but that the weekly and annual fluctuations in their death-rate are practically identical with those of rheumatism. It was therefore concluded that erysipelas and puerperal fever should be classed not as epidemic but as endemic diseases.

PROF. E. QUETELET has published the climatological elements of Brussels in a series of eighteen tables, with descriptive letter-press, for the ten years ending 1873, as part of a public statistical document of Brussels relative to this ten-year period, and which has been printed with the title "Statistique générale de la Ville de Bruxelles."

IN a circular letter addressed to the Presidents of the Departmental Meteorological Commissions, dated January 29, M. Leverrier points out that, in developing the system of weather-forecasts for agriculturists, attention must be paid not only to the quantity of rain which falls, but also to the way in which the fall is propagated from canton to canton and from department to department. The manner of propagation of the rainfall it is proposed to represent by means of curves, and the Commission are requested to assist in the work so as to render it possible to construct such charts for the whole of France, and in consideration of the immense labour of the undertaking, skilled meteorologists are invited to lend their assistance in the preparation of these novel but highly-important charts. Still greater precision in stating the local circumstances connected with remarkable hail-storms is insisted on, particularly when it is considered that though everyone knows hail to fall in very different quantities in districts immediately contiguous to each other, and individual cantons and communes to be notorious for their destructive hail-storms, yet the influence of woods, forests, river-courses, and hills is a question still unsolved. This conception of Leverrier's with reference to the vitally important bearing on the meteorology of a country of a comprehensive observation of the rainfall, hail, and thunderstorms, by numerous observers possessing sound local information, is not merely eminently just in science, but augurs well for a satisfactory solution of the peculiarly important but difficult problem he has taken in hand.

THE "Annuaire météorologique et agricole de l'Observatoire de Montsouris pour l'An 1876" (pp. 442) has just appeared, containing a good many matters not included in previous issues, of which the most interesting are a chart showing the lines of equal magnetic declination for France and parts of the countries adjoining, a table showing the successive values of the declination from 1550 to 1875, a chapter on atmospheric electricity, a

table giving the mean temperature of Paris for each day of the year, calculated from sixty years' observations, a comparison of the mean hourly observations from March to September, between the thermometer in shade and Becquerel's electric thermometer, fixed at a height of sixty-five feet above the ground; and a variety of tables, partly chemical and partly meteorological, bearing on agriculture.

DR. E. PERCEVAL WRIGHT, M.A., F.L.S., was, on the 5th inst., re-elected Professor of Botany and Keeper of the Herbarium in the University of Dublin.

THE Royal Irish Academy has lately shown a large amount of literary life. Its publications consist, like those of most of our chartered societies, of Transactions and Proceedings. Of the Academy Transactions during the last twelve months twelve parts have been published; it is noteworthy that these parts, each containing a single memoir, have been published within a few weeks after they have been read. Among them we notice Mr. Jellet's memoir on Chemical Optics, Mr. Stoney's report on Riveted Joints, Dr. Macalister's report on the Anatomy of Insectivorous Edentates, Mr. Baker's report on the Seychelles Fern Flora, Dr. Doberck's four memoirs on various Binary Stars, and on the first Comet of 1845, Dr. Hart's memoir on the Nine-point Contact of Cubic Curves, Mr. Mackintosh on Echini Spines, and Prof. King on Jointing. The Scientific Proceedings during the same period have been published quarterly, and the four parts contain thirty-seven memoirs, not of sufficient importance for the Transactions, which are illustrated by thirty-four plates and many woodcuts. One long report by Rev. E. O'Meara on Irish Diatomaceæ will be of interest to all microscopists, while many of the papers by Dr. Macalister, Mr. Archer, Mr. Mackintosh, Mr. Burton, Dr. McNab, Dr. Leith Adams, are of very considerable importance. Speedy publication is the very life of science, and we trust the Irish Academy will indulge, in this respect, in a generous rivalry with the cognate London societies. The separate publication of the memoirs is a boon to the working student, who cannot always afford to buy a large volume of some 600 pages for the sake of perhaps one small memoir.

THE Royal Commissioners on Vivisection have signed their report, which will forthwith be despatched to her Majesty.

M. BERTHELOT, the celebrated chemist, is a candidate in the moderate Republican interest for the representation in the French Chamber of Deputies, of the district in which the Institute is situated.

WITH this month's number of Petermann's *Mittheilungen* is a map of the African west coast from 3° to 6° S. lat., showing the results obtained by the German African Expedition. A short paper by Dr. Güssfeldt states briefly the bases on which the map is constructed. Its special value lies in the fact that it is almost wholly constructed from materials obtained by the personal observation of Dr. Güssfeldt. The same number contains the continuation of the account of the recent Paris Geographical Exhibition. Dr. A. Schreiber, who lived six years in Sumatra, contributes an important paper on the Southern Batta Lands of that island; the paper is accompanied by an excellent and full map of that portion of the island between the equator and 2½° N. lat., and westward of the 100th degree of E. long. The number contains what may be regarded as a complete geographical necrology for 1875. It comprises thirty-six names, and how wide Dr. Petermann's interpretation of the word geography is may be learned from the fact that among these names are those of Sir Charles Lyell, Sir W. E. Logan, and Dr. von Willemoes-Suhm. The number concludes with the continuation of Dr. Conto de Magelhaes' account of his travels in Uruguay.

THE *Geographical Magazine* for February contains a brief but clear account of the work accomplished by Cameron. Major Wood's paper on former physical aspects of the Caspian is continued, and Prof. Giglioli contributes translations of letters from Dr. Beccari, the Italian explorer of New Guinea; a map accompanies these letters.

THE December number of the *Bulletin* of the French Geographical Society contains the abstract of the diary of a Rabbi who recently journeyed from Mogador in Morocco to the Djebel Tabayoudt. The Abbé Durand's valuable paper on the basin of the Madeira, S. America, is concluded, and M. Fournier contributes some recent information on Mozambique and the production of the basin of the Zambesi. M. V. A. Malte-Brun reports on Dr. Van Raemdonck's work on the terrestrial and celestial spheres of Mercator. In connection with the proposed erection of a Central Meteorological Observatory on Mont Pie, Abbé Perrier gives some account of that mountain. It is in the middle of the Graian Alps, 3,593 metres above the sea, nine kilometres from the town of Aosta.

AMONG the notices of motion in the House of Commons on the opening day of Parliament, were one by Sir John Lubbock to introduce his National Monuments' Bill, and another by Mr. Mundella of a Bill for the establishment of Free Libraries, Museums, and Institutions for the Teaching of Science and Art.

THE French Association for the Advancement of Science opens its next Congress at Clermont-Ferrand on August 17 next.

VOL. V. Part II. of the *Natural History Transactions of Northumberland and Durham* contains the Presidential Addresses for 1874 and 1875. The most important contribution to the part is an interesting Memoir of the Life of the late Albany Hancock, by Dr. Embleton, which ought to prove acceptable to all naturalists. A beautifully-executed steel portrait accompanies the memoir, and appended is a list of seventy-three works, mostly contributions to various journals, written either wholly by Mr. Hancock, or in conjunction with some one else. Dr. Embleton also contributes a paper on the Vendace (*Coregonus Willoughbii*, Yarrell, *C. Marœnula*, Jardine and Jenyns), and Mr. G. C. Atkinson a second instalment of a Catalogue of the more remarkable Trees of Northumberland and Durham.

ANOTHER catastrophe has befallen the Island of Réunion. On Dec. 22, 1875, a terrific cyclone, accompanied by a thunderstorm, deluged St. Denis, the chief town. The whole island, fifty miles long, by thirty miles broad, was more or less damaged; but the loss of life has been smaller than when the landslip occurred a month previously.

WE have received a copy of the first number of *The American Journal of Microscopy*, a new monthly paper published at New York, which has commenced in an unpretentious manner, the object of the editor evidently being to increase it if he finds that the plan of its construction suits it to the wants of a sufficiently large circle of contributors.

AT the last meeting of the Eastbourne Natural History Society, Dr. Ogier Ward read a paper on the Hill-Forts of Sussex.

THE additions to the Zoological Society's Gardens during the past week include a Panda (*Ælurus fulgens*) from Nepal, deposited; a Hobby (*Hypotriorchis subbuteo*), and a Common Kestrel (*Tinnunulus alaudarius*), captured in the Red Sea, presented by Mr. S. Baton; a Bonnet Monkey (*Macacus radiatus*) from India, presented by Mr. E. Darwell; two Snowy Egrets (*Ardea candidissima*) from America, purchased; a Red-crested Cardinal (*Paroaria cucullata*) from S. America; two Amaduvade Finches (*Estrelda amadava*) from India, presented by Mr. Peter W. Barlow, jun.; a Swainson's Lorikeet (*Trichoglossus swainsoni*) from Australia, presented by Mrs. G. F. Angas.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Jan. 20.—Certain cases of electromotive force sustained by the action of electrolytes on electrolytes, by J. Hopkinson. Communicated by Sir W. Thomson.

On reversed photographs of the solar spectrum beyond the red, obtained on a collodion plate, in a letter to Prof. Stokes, by Capt. J. Waterhouse, Assistant Surveyor-General of India. Communicated by Prof. Stokes.

Jan. 27.—Contributions to the minute anatomy of the thyroid gland of the dog, by E. Cresswell Barer, M.D., Lond. Communicated by Dr. Klein, F.R.S.

Results of the monthly observations of magnetic dip, horizontal force, and declination made at the Kew Observatory, from April 1869 to March 1875 inclusive, by the Kew Committee.

Researches on the minute anatomy of the alimentary canal, by Herbert Watney, M.A., Demonstrator of Microscopical Anatomy at St. George's Hospital. Communicated by Dr. Klein, F.R.S., Assistant Professor in the Brown Institution.

Linnean Society, Jan. 20.—Prof. G. J. Allman, F.R.S., president, in the chair.—Prof. Oliver communicated a short paper, by Prof. H. G. Reichenbach, being the twenty-ninth contribution to the botany of the *Challenger*, viz., On some Orchidaceæ collected by Mr. Moseley of the *Challenger* expedition, in the Admiralty Islands, Ternate, and Cape York—one of which forms the type of a new section of the genus *Dendrobium*.—The Fungi of Brazil, by the Rev. M. J. Berkeley and Dr. M. C. Cooke. The authors include the collection made by Mr. J. H. Trail in 1874, and state that all the Brazilian fungi yet known amount to but 437 species. Among these there are of Hymenomycetes, 356; Gasteromycetes, 13; Hyphomycetes, 7; Coniomycetes, 5; Ascomycetes, 55; incomplete, 1—total, 437. About 300 of these are confined to Brazil, the remainder found in other parts of the world. The great Brazilian region, therefore, with but 437 representatives, contrasts with 886 enumerated for Cuba, and 1,190 for Ceylon. This paucity of species in the first-mentioned area, the authors suggest, may be due to incompleteness of collection, or presumably as yet deficient knowledge of microscopical forms.—On a new species of oak from the Sikkim Himalaya, by Dr. George King, F.L.S., Supt., Roy. Bot. Gard., Calcutta. This, the *Quercus Andersoni*, or "Katoos" of the Nepaulese, is one of the finest forest trees, and largely used by the European residents of Darjeeling. It occurs at higher altitudes than *Q. spicata*, and in other respects differs.—On Steere's sponge, a new genus of the Hexactinellid order of the Spongidæ, by Dr. James Murie. Obtained in deep water between the islands of Negros and Zebu, the present adds one more rarity to the already remarkable sponge fauna of the Philippines. The siliceous skeleton of *Dendrospongia steerei* bears resemblance to a branching coral or shrub, and is nearly three feet high. A peculiar rosette-like series of tufts form a continuous whorl, winding spirally up the branches. Microscopical examination shows the spicules to belong to the sex-radiate type: the character of these, with the presence of a veil and other structural points, indicate its being an intermediate type between such forms as *Dactylocalyx*, *Aphrocallistes*, *Holtenia*, and *Meyerina*. The homology of the so-called root, body, and beard spicules of several of the siliceous sponges being noted, those of *Dendrospongia* are compared; the spiral tufts of the latter agreeing in many respects with the spicular fringes of *Euplectella*, &c.

Chemical Society, Feb. 3.—Prof. Abel, F.R.S., president, in the chair.—Mr. W. Ackroyd read a paper on metachromism, or colour change. Metachromism, from the Greek μετά, change, and χρῶμα, colour, is the term applied to the phenomenon investigated, viz., the change in colour observed in bodies when heated at comparatively low temperatures. For convenience sake colour-changing bodies were called metachromes. No mention is made of the subject in text-books, and only here and there in scattered memoirs. The views of Stahl, Delaval, Brewster, Schœnbein, Gladstone, and Houston and Thomson were spoken of and discussed. *Colour change takes place in the order of the spectrum colours: when a metachrome is expanding, in the violet to red order; when contracting, red to violet order.* Such colour change it was pointed out might be taken as an indication of expansion or contraction, the anomalously behaving body AgI fully bearing out the author's conclusions. Metachromes were divided into two classes: (1) the zinc oxide class; and (2) the borate of copper class. From a study of the two classes the following metachromatic scale was arrived at: white, colourless, violet, indigo, blue, green, yellow, orange, red, brown, black—metallic appearance. The colours of the more refrangible end may be replaced by a metallic appearance. Metachromism has an important bearing on allotropy. A body expanding through the influence of heat being really a continuous series of allotropes. In support of this the relation of colour and density was discussed. It was shown that metachromism is due to the storage of potential energy, the author holding that molecular vibrations or kinetic energy have nothing to do with this phenomenon of selective absorption. Contracting metachromes changing from less to more refrangible colours, where would this change cease providing a long enough temperature could be had? Presumably at the absolute zero of temperature, and at this point all metachromes would be white or metallic-looking, judging from their behaviour at attainable temperatures. Following expanding metachromes from this *absolute zero of colour*, the change in each would vary with the coefficient of expansion, giving us at the normal temperature all that diversity of hue which characterises the inorganic world. Including certain cases of decomposition (given in table) colour change may denote (1) If to more refrangible, α contraction or β decomposition; (2) If to less refrangible, α expansion or β combination. The observations relate to anhydrous and for the most part binary compounds.—Mr. W. H. Perkin, F.R.S., made a communication on the formation of anthra-purpurin, which it appears is the product of the action of caustic alkali on anthraquinone-disulphoric acid. The supposition that alizarin is formed under these circumstances being incorrect.—There were also papers on mattose, by Mr. C. O. Sullivan; on a simple form of gas regulator, by Mr. J. Fletcher; and on high melting points, with special reference to those of metallic salts, by Mr. T. Carnelley, B.Sc.

Zoological Society, Feb. 1.—Mr. G. R. Waterhouse, vice-president, in the chair.—The Secretary read some extracts from a report of a recent visit made by H.M.S. *Petrel* to the Galapagos Islands, communicated by the First Lord of the Admiralty, and referring to the tortoises met with in the different islands of the group.—Mr. Sclater exhibited and made remarks on an antler of a Rusa Deer, living in the Gardens of the Acclimatisation Society of Melbourne, which had been sent to him for identification.—Mr. Frederick Selous, jun., exhibited and made remarks on a series of horns of African Rhinoceroses procured by himself in South-eastern Africa.—Prof. T. H. Huxley, F.R.S., read a paper on the position of the anterior nasal aperture in Lepidosiren, which he showed to be strictly homologous with the position of these organs in other vertebrates.—Mr. A. H. Garrod read a paper on the anatomy of *Chauna derbiana*, and on the systematic position of the Screamers (*Palamedeidæ*), in which he controverted Prof. Parker's collocation of this form with the Anseres, and showed that it should occupy an independent position with relations to the Struthiones, Gallinæ, and Rallidæ.—A communication was read from Mr. F. Jeffrey Bell, containing notes on the myology of the limbs of *Moschus moschiferus*.—A communication was read from Dr. T. Spencer Cobbold on Entozoa, forming the third of a series of papers on this subject brought by him before the Society.—Mr. Herbert Druce read a list of butterflies collected in Peru, with descriptions of new species. To these were added some notes on some of the species, by Mr. Edward Bartlett.—Mr. A. G. Butler read some notes on a small collection of butterflies received from the New Hebrides.—A paper by Mr. P. L. Sclater and Mr. O. Salvin was read, in which they gave descriptions of some new birds obtained by Mr. C. Buckley, in Bolivia.

Physical Society, Jan. 29.—The president, Prof. Gladstone, F.R.S., in the chair.—The following candidates were elected members of the Society:—Sir John Conroy, Bart., and H. S. Burls.—The Secretary then read a communication from Mr. J. A. Fleming on the polarisation of electrodes in water free from air. The experiments described were undertaken in order to meet objections which had been raised by Prof. Rowland to a previous paper by the author, in which he endeavoured to show that when an electrolyte flows in a very strong magnetic field the electromotive force generated by its motion effects the electrolysis of the liquid, a fact which he holds to be proved by the subsequent polarisation of the electrodes. Prof. Rowland considered that the effect observed was due to the presence of dissolved air, and conversely, that in air-free water, at any rate with the same electromotive force, similar effects would not be observed. These doubts raise the two questions (1) in air-free water can platinum electrodes be polarised by a very small electromotive

force to the same degree and with the same facility as in aërated water, and (2) is this very feeble polarisation really a decomposition of the electrolyte? To test the first point experiments were made with a voltameter containing dilute sulphuric acid which had been previously boiled, the voltameter being connected with a Sprengel pump. The platinum plates were acted on by a very small external electromotive force for one minute, and the effect of the polarisation current due to this action noticed on an extremely delicate galvanometer, the effect of the direct current employed being also noted. After a series of observations had been made, using different amounts of electromotive force, the dilute acid was removed, and, after being thoroughly aërated, replaced in the voltameter. On repeating the experiments with this one change in the conditions, the results obtained were almost identical, from which fact the author concludes that the first question may be answered in the affirmative. With regard to the second, Mr. Fleming believes that the assertion that polarisation is decomposition of the electrolyte has never been called in question, and in proof of it, describes an experiment showing that when acidulated water flows rapidly past slightly polarised plates, the current which they give is very much diminished, while by causing the water to flow slowly but slight change is produced. This seems to indicate that there is something on the plates which can be *wiped off* mechanically, and it can only be a product of electrolysis.—Prof. Foster, while admitting the accuracy of Mr. Fleming's experiments, doubted whether he was justified in definitely ascribing polarisation to chemical action. He thinks that, even though the effect be proved not to be due to dissolved air, we must look for some cause other than chemical action. For it has long been acknowledged that the decomposition of water requires an electromotive force considerably in excess of that employed in these experiments.—Prof. Gladstone then made a brief communication on the photography of fluorescent substances. He exhibited several photographs taken of white paper on which devices had been previously drawn, with solutions of sulphate of quinine, œsculine, &c., and one was taken in the room. He remarked that the leaves of trees come out dark in a negative, as they contain the fluorescent substance chlorophyll, and suggested that the irregularities of colour observed in photographs of oil paintings are probably due to the intermixture of fluorescent substances in the paints used.—Mr. Meldola referred to Prof. Vogel's experiments on the effect produced on the resulting photograph by the addition of a fluorescent substance to the collodion, thereby increasing the sensitiveness of the plate to particular rays.—Mr. S. P. Thompson, B.A., B.Sc., then gave a summary of the recent experiments made in America by Mr. T. E. Edison, Dr. Beard, Prof. Houston, and others upon the new phase of electric manifestation, the so-called etheric force. This force is characterised by a faint spark, the only evidence, in fact, yet known of its existence. It may be obtained from the iron core of any electro-magnet, or from a metallic bar slipped into the coil in place of the core, but only when the battery circuit is being interrupted, as may be done by introducing into the circuit an automatic contact breaker. The sparks so produced are apparently without polarity, devoid of chemical or physiological effect, affect neither electroscopes nor galvanometers, and are stated to be retroactive, being exhibited when one end of a wire through which they are passing is brought round to touch the wire. A detailed description was then given of experiments on this force conducted in the Physical Laboratory at South Kensington, some of which were confirmatory of the published researches of the discoverers, while others were at variance with them. Great pains had been taken to avoid leakage and to distinguish the effects from those of ordinary induced currents. The batteries and coils employed were insulated from the earth as well as from the other portions of the apparatus. A bar of zinc placed above the poles of a powerful electro-magnet, or within its coils, was found to give better results than one of cadmium, which is recommended by the discoverers. The sparks, which resembled those of dynamic electricity, were of inappreciable length and far too faint to ignite gun-cotton or illuminate a delicate Geissler's tube. It was also found that when a bar of zinc was placed within the coil of an electro-magnet in the place of its core and joined by a wire to the gas fittings of the building, faint but distinct sparks could be drawn from any portion of this wire by a second wire proceeding from another part of the gas pipes. Another peculiar effect was observed when the wire attached to one end of the zinc bar, and armed at its extremity with a thin iron wire, was rubbed lightly against the other end of the zinc bar—sparks being thus obtained, apparently passing from one pole of the zinc bar, through the wire, to the other.—Dr. Stone believed he had detected a distinct galvanic taste on applying to the tongue the wire through which the "force" was passing.—Prof. Foster suggested the use of an electro-dynamometer to ascertain the electromotive force of the current exhibiting these sparks, as its indications would be independent of direction of current.

Royal Microscopical Society, Feb. 2.—Anniversary Meeting.—H. C. Sorby, president, in the chair.—The Report of the Council and the Treasurer's Annual Statement of Accounts were submitted to the Fellows, and showed that the Society was, at the present time, in a satisfactory and prosperous condition. Votes of thanks to the President and Council for their services during the past year were proposed by Mr. J. Glaisher and carried unanimously. The President then delivered the address, the subject of which was the probable limit of the powers of the microscope with reference to the ultimate size of the molecules of matter, and the general bearing of the conclusions arrived at upon the various germ theories. The following gentlemen were elected as Officers and Council for the ensuing year:—President, Henry Clifton Sorby, F.R.S. Vice-presidents: Charles Brooke, F.R.S., William B. Carpenter, F.R.S., Rev. W. H. Dallinger, Hugh Powell. Treasurer, John Ware Stephenson, F.R.A.S. Secretaries: Henry J. Slack, F.G.S., Charles Stewart, F.L.S. Council: Robert Braithwaite, F.L.S., Frank Crisp, LL.B., John E. Ingpen, Emanuel Wilkins Jones, F.R.A.S., William T. Loy, Henry Lawson, M.D., John Millar, F.L.S., John Rigden Mummery, F.L.S., John Matthews, M.D., Frederic H. Ward, M.R.C.S., Francis H. Wenham, C.E., Charles F. White. Assistant Secretary, Walter W. Reeves.

Institution of Civil Engineers, Feb. 1.—Mr. Geo. Rob. Stephenson, president, in the chair.—The paper read was on the "Holyhead New Harbour," by Mr. Harrison Hayter, M. Inst., C.E.

Victoria (Philosophical) Institute, Feb. 7, Mr. C. Brooke, F.R.S., in the chair.—After the election of new members it was stated that during the past year thirty-three town, sixty-four country, and eighteen foreign and colonial members had joined. A paper on "Heathen Cosmogonies compared with the Hebrew" was read by the Rev. B. W. Savile.

PHILADELPHIA

Academy of Natural Sciences.—During 1875 a large number of interesting papers and communications were read.—Prof. Cope, in describing some vertebrate fossils from the Saskatchewan district, said that they gave indications of the future discovery of a complete transition from Cretaceous to Eocene life. The collection was chiefly remarkable for the great number and variety of Dinosaurian remains. In another paper Prof. Cope attempted to trace the evolution of the sectorial tooth of Carnivora from the simple quadri-tuberculate molar. He regards the process as having consisted first in an addition of an anterior cusp, and subsequently in the loss of internal and posterior cusps. There had been a progressive extinction of genera with numerous sectorial teeth, with an increasing specialisation of the sectorial tooth in the surviving genera. Parallel with this change was another, in the character of the tibio-astragalar articulation, which he believed to indicate that the American Eocene Carnivora were plantigrade. In describing a new Mastodon from Santa Fé, Prof. Cope divided the North American Mastodons into two groups, the first having teeth with continuous cross-crests divided by a fissure only, the other having transverse series of two or more deeply-separated tubercles. Comparatively recently Prof. Cope announced the discovery of vertebræ and other remains from Illinois, which appear to give the first definite indication of the existence of Rhynchocephalous lizards in the western hemisphere.—Prof. Leidy's contributions have referred chiefly to Rhizopods and Vermes, and to Vertebrate Palæontology. He described a remarkable Rhizopod, which he compared to the reticular pseudopods of a Gromia separated from the body. At one time it appeared as an extremely thin disc with a multitude of minutely ramified and anastomosing pseudopods proceeding from its edge. At other times it divided up into branches from a trunk like a tree. Again it would assume the form of a cord, and the jelly accumulating at some portion of it would run along it like a drop of water on a piece of twine. A granular circulation was observable as in Gromia.—Mr. T. G. Gentry presented an important paper on the phylogeny of the Lepidoptera, suggested by an anomalous development of certain larvæ of *Acronycta oblinita*, without the slightest attempt at cocoon-making.

Other instances among insects were adduced to show the important influence of the surroundings of a species in producing functional changes in its economy, and it was sought to be established that defective nutrition has been a principal cause of cocoons being dispensed with by certain Bombycidæ. From these preliminary considerations the author proceeds to consider the evolution of the various families of Lepidoptera. He believes that the butterflies have as a whole been developed from the Bombycidæ, though that development has probably been accomplished through several roads. He claims the support of palæontological evidence for his views. The earliest moths yet recorded are the Tineids, the lowest family of Lepidoptera; these may be regarded as constituting a persistent type like that of Terebratulas. The Sphinges are supposed to have descended from a Phryganea with Bombycid characters, and many ingenious suggestions and considerations are advanced in support of this view. A hypothetical genealogical tree is given at the close of the paper.—A monographic account of *Nisus* (*Accipiter*) *cooperi* and *N. gundlachi*, by Mr. R. Ridgway, gives the results of careful examination of many specimens. With regard to the former it is found impossible to establish the existence of two geographical races. The distinctness of the latter species is strongly maintained. Mr. Ridgway's account of the Buteonine sub-genus, Craxirex, which is peculiar to America, gives a synopsis of the species. The very variable *Buteo swainsoni* is particularly fully described.—A very interesting paper is contributed by Dr. Elliott Coues, devoted to a vindication of William Bartram as a scientific ornithologist. Dr. Coues seeks to prove that, according to the admitted rules of nomenclature and the rules of the British Association, Bartram has not received his due. He maintains that Bartram's Catalogue of United States Birds is not a mere valueless list, but all the more valuable in consequence of the terseness and simplicity of his descriptions, many of which are unmistakable.—One of the most important papers of the year is by Dr. Lautenbach, on the physiological action of hemlock and its alkaloid. His conclusions, from careful experiments, are as follows:—1. Conia, instead of being poisonous to plants, really acts as a preservative; the alcoholic extract of hemlock, however, acts poisonously on plants. 2. When locally applied, conia produces a progressive loss of functional power in every highly organised tissue with which it comes into contact. 3. In inducing complete repose of the muscular system, conia powerfully predisposes to sleep, but it is not a hypnotic in the sense that opium is. 4. The convulsions produced by a poisonous dose of hemlock are cerebral, and not spinal, as has heretofore been imagined. 5. Conia produces a double effect on the motor-nervous system, a paralysing effect on the periphery of the efferent or motor nerves, and a depression of the motor tracts of the spinal cord. 6. The increase in the number of heart-beats which occurs early in conia poisoning is due to paresis of the pneumogastrics. 7. The primary acceleration in the respiratory movements is also due to pneumogastric paresis. 8. The salivary secretion is the only secretion markedly increased by a poisonous dose of conia. 9. The voluntary muscles escape unscathed in conia-poisoning. 10. Contraction of the pupil only occurs when the drug is directly applied to the eyeball. 11. Conia causes a decided increase in temperature. 12. Conia is absorbed and is eliminated unchanged by the kidneys.

PARIS

Academy of Sciences, Jan. 31.—Vice-Admiral Paris in the chair.—The following papers were read:—Thermal researches on the formation of alcohols and on etherification, by M. Berthelot.—Account of experiments made to determine the work expended by Gramme's magneto-electric machines, used for producing light in the works of MM. Sautter and Lemonnier, by M. Tresca. A direct-illumination photometer was used for comparing an electric lamp with a Carcel lamp, and when equality was had in the two contiguous zones, a dynamometer trace was taken, and the number of turns ascertained. The author gives data of machines, the light from which was equal to 1,830 and 300 Carcel burners respectively. The cost of fuel for the former was only about a hundredth of that of the oil and a fiftieth that of the coal gas.—M. Du Moncel presented the fourth volume of his "Exposé des Applications de l'Electricité" (3rd edition), relating to electric clockwork, electric registers, and applications of electricity to safety appliances in railway service.—Researches on magnetic rotatory polarisation (2nd part), by M. Becquerel. The rotation in diamagnetic bodies increases with the index of refraction. In solutions of a diamagnetic salt of varying concentration, the ratio of the rotation to the weight of the anhydrous salt is a number nearly constant. With salts of iron the magnetic rotation increases much more quickly than the number of active molecules.—Calorific vibrations of a homogeneous solid of uniform temperature, by M. Lucas.—On the formation of hail (second note), by M. Planté. The electrodes of the secondary couples are introduced into salt water, the positive being covered with moistened blotting-paper. A multitude of ovoid globules are scattered out and up from this latter in all directions. M. Planté thinks the electricity in clouds may sometimes act thus, and the globules, rising to a region of lower temperature, become hailstones. Electricity may produce hail through mechanical, calorific, or magneto-dynamic effects.—Letter to the President of the Commission on Phylloxera, by M. Mouillefert.—On the boring operations in the tunnel of Saint Gothard, by M. Colladon. Notwithstanding much greater hardness of rock, &c., than in the boring of Fréjus. M. Favre has, in the third year, realised an advance of 48½ per cent. above the maximum obtained in Fréjus during the thirteen years.—Discovery of the planet (159), by M. Paul Henry.—Note on left curves of the fourth order, by M. Serret.—On the principle of correspondence, and the means it affords of removing some difficulties in analytical solutions, by M. Saltel.—On topographic maps, by M. Hermite.—On the congelation of mercury by use of a mixture of snow and hydrochloric acid, by M. Witz. A mixture, in equal parts, of snow and hydrochloric acid having a temperature of $-1°$, will give a temperature of $-37°{\cdot}5$ C.—On electrolytic aniline black, by M. Goppelsroeder.—On the ferment of urea, by M. Musculus. It has none of the properties of organic ferments, but is rather like soluble ferments, as diastase, saliva, and pancreatic juice.—On the elements of inverted sugar, and their presence in commercial sugar, by M. Maumené.—On digestion in insects; remarks *àpropos* of a recent work of M. Jousset, by M. Plateau. M. Plateau claims priority of observation.—Note on the method to be employed for testing the conductivity of lightning conductors, by M. Michel.—Observations relative to the undulations and fractures of the Cretaceous system, *àpropos* of the project of making a tunnel under the Channel, by M. Robert.—On spontaneous periodic movements in the stems of *Saxifraga sarmentosa*, *umbrosa*, *Geum*, *Acanthifolia*, and in *Parnassia palustris*; relations of this phenomenon with the disposition of the foliar cycle, by M. Heckel.

BOOKS RECEIVED

BRITISH.—Three Months in the Mediterranean: Walter Coote (Stanford).—Lardner's Handbook of Astronomy. 4th edition. Edited by E. Dunkin, F.R.A.S. (Lockwood).—British Manufacturing Industries. Edited by G. Phillips Bevan, F.G.S. 3 vols. (Stanford).—The Races of Mankind. Vol. III.: Dr. Robert Brown (Cassell).—Morocco and the Moors: Dr. Arthur Leared. (Sampson Low and Co.)—Memoir of Commodore Goodenough: C. R. Markham (G. Griffin and Co.)—Animal Parasites and Messmates: P. J. Van Beneden (H. S. King and Co.)—First Book of Zoology: E. S. Morse, Ph.D. (H. S. King and Co.)—Livingstone's First and Second Expeditions to Africa. 2 vols. (John Murray)—Reboisement in France: J. Croumbie Brown, LL.D. (H. S. King and Co.)—Telegraphy: W. H. Preece, C.E., and J. Sivewright, M.A. (Longmans).—Tyrol and the Tyrolese: W. A. Baillie Grohman (Longmans).—Food: its Adulterations and the Methods for their Detection: Dr. A. Hill Hassall (Longmans).—Physical Geography: W. D. Cooley (Dulau and Co.)—Short History of Natural Science: A. B. Buckley (John Murray).

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